MARKETING OPPORTUNITIES IN THE PHOTOVOLTAIC INDUSTRY

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY, ENVIRONMENT,
AND SAFETY ISSUES AFFECTING
SMALL BUSINESS

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MARKETING OPPORTUNITIES IN THE PHOTOVOLTAIC INDUSTRY

THURSDAY, DECEMBER 9, 1982

House of Representatives, Subcommittee on Energy, Environment, and Safety Issues Affecting Small Business, Committee on Small Business,
Washington, D.C.

The subcommittee met, pursuant to notice, at 1:35 p.m., in room 2359-A, Rayburn House Office Building, Hon. Berkley Bedell (chairman of the subcommittee) presiding.

OPENING STATEMENT OF CHAIRMAN BEDELL

Mr. Bedell. The subcommittee will come to order.

In the past 4 years, this subcommittee has devoted considerable time and effort in studying the photovoltaic industry. Photovoltaic technology was born in the United States with its roots in our early space exploration efforts. Since those days, PV energy systems have improved in efficiency and dropped in price to the point where the international sales potential for solar-powered equipment may run into the billions of dollars. To put it bluntly, the reason we are holding this hearing today is because I am afraid America may lose out in the competition for this vast market. I am afraid that other nations are going to run us out of the international PV market using our own technology. I am afraid that U.S. jobs and U.S. exports will be transferred overseas to our competitors because of this administration's failure to recognize and foster the tremendous potential of our photovoltaic energy industry.

Finally, I am afraid that our foreign competitors will eventually beat out our own domestic industry for the lion's share of the PV market right here in the United States.

Without a doubt, there is a substantial demand for photovoltaic equipment in developing countries. PV energy is now price competitive with more conventional forms of energy in remote areas. Reliable, renewable energy sources are anxiously sought for applications such as irrigation, communications, refrigeration, and small-scale electrical generation. When I was in Africa as a congressional observer at the U.N. Conference on Renewable Energy, I was very impressed with the innovative concepts applied to photovoltaic energy systems that immeasurably improved the quality of life in some of the world's poorest and most remote outposts.

I would be less than honest if I did not say in public what I have been saying in private to Government officials from the Secretary of Energy on down. I am dismayed by the way this administration is treating the development of photovoltaics.

The drastic budget cuts in the PV research and development program at the Department of Energy have set back several promising new technologies and threaten to give our foreign competitors a technological edge in some of these areas that we may never overcome. In addition, I am concerned that small companies, who need research assistance the most, are getting short changed in the allocation of DOE funds for the photovoltaic program.

Further, I am concerned about the administration's frequently stated desire to eliminate commercial and residential energy tax credits. This proposal has met with strong congressional opposition, and the administration has retreated temporarily. One can only speculate on how many projects are now in limbo because of the uncertainty created by this ill-conceived notion.

Also disturbing to me is what appears to be a new policy implemented by the Department of Energy to restrict the free flow of information about the Department's past research efforts in photovoltaics. There have been recent incidents of DOE's projects being represented by empty booths at various industry trade shows and seminars. In contrast to the unabashed zeal with which the Department's representatives promote nuclear power, solar energy is being treated like an unwanted stepchild.

Finally, it is apparent that our Nation has a lot to learn about international marketing. It may be good politics to preach laissez faire economics on the campaign trail, but it is all too clear that other governments do not play by the same rules that we have imposed on our industry. The simple fact is that our Government does precious little to help U.S. small businesses develop markets overseas, even when they must compete with firms which are actively supported by their governments. Some of the witnesses testifying this morning will tell us of their experiences marketing renewable energy technologies abroad.

I am pleased to note that today's witnesses represent a broad cross-section of individuals who are committed and respected members of the photovoltaic industry.

We will also be hearing from representatives of those Federal agencies which have the most direct responsibility for helping our domestic industry compete for the growing international PV market.

Unfortunately, Mr. Mavroules could not be here today because of a death in the family. His interest in this topic is very great, and at this point I would like to insert his opening statement into the record.

[Representative Mavroules' opening statement follows:]

OPENING STATEMENT OF HON. NICHOLAS MAVROULES, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MASSACHUSETTS

Mr. Chairman, thank you for allowing me this opportunity to comment briefly on the future of photovoltaic technology and the role small business can play in that future.

As you all know, I have long been an advocate of renewable energy technologies as a means of dealing with our ever-increasing demand for more energy and of reducing our unhealthy dependence on foreign oil.

In particular, I believe that the development of solar energy—in the private and public sectors—holds great promise for our energy future and security. Photovoltaic systems, over the past 25 years, have been shown to be highly reliable and workable energy resources. I feel this is an area in which small businesses could greatly benefit and prosper.

Unfortunately, Federal budget constraints on the development and application of energy renewables have placed a severe strain on America's energy stability.

All federally supported solar and alternative energy research has been virtually eliminated at the very time when other countries such as France, Germany, and Japan are increasing their support. I am afraid that this not only costs the United States an advantage in the current market for the technology itself, but it could create substantial problems in the future if we must turn to other countries for this same technology.

Our Government does have a very crucial role in developing these renewable energy technologies, and its about time that it plays that role.

We've already made one step in that direction. The Department of Defense has been directed, thanks to legislation I authored, to use energy systems powered by photovoltaics and other renewable energy sources wherever cost-effective or strategically necessary.

The "Department of Defense Renewable Energy Utilization Act" recognizes the hard fact that we can no longer afford to waste our precious nonrenewables when there are renewable energy alternatives available today.

This bill, I hope, will promote the growing market for energy systems powered by solar and other renewable forms of energy and will hasten the general commercial, residential, industrial, agricultural and governmental uses of such systems in the United States and abroad.

I am pleased, Berkley, that you too are active in promoting the development of renewable energy resources. I hope that through these hearings Congress will renew its interest in solar power in the next session.

Mr. BEDELL. I am also pleased that Congressman Hiler is here. I appreciate, Jack, the way you participate so faithfully in these matters, and I would now yield to Mr. Hiler.

Mr. HILER. No statement, Mr. Chairman.

Mr. BEDELL. Thank you.

Our first panel this afternoon is made up of Paul Maycock, of the Photovoltaic Energy Systems, Inc., and Roger G. Little, of Spire Corp., in Bedford, Mass.

Mr. Little has been a participant in the DOE's photovoltaic development and research effort for quite some time. He has also served as an adviser to the Energy Research Advisory Board's solar panel. We are pleased to have you with us today.

Mr. Maycock is a figure who is familiar to everyone in this room. I want to thank you, Mr. Maycock, for the work that you have done in this area. I also ask all of the witnesses to summarize as much as possible. My understanding is we have to be out of this room by 4 o'clock, and we have quite a number of witnesses.

PANEL CONSISTING OF PAUL D. MAYCOCK AND ROGER G. LITTLE

TESTIMONY OF PAUL D. MAYCOCK, PRESIDENT, PHOTOVOLTAIC ENERGY SYSTEMS, INC., ALEXANDRIA, VA.

Mr. MAYCOCK. Yes, sir.

Mr. Chairman, members of the committee, when you asked me to participate in this hearing, I was somewhat reluctant for fear that my comments might be considered sour grapes. As you remember, in January 1981, I was managing the Department of Energy's photovoltaic program with a budget of $160 million, a well-balanced research development test and applications engineering effort, when the Office of Management and Budget called for the 1982 budget, was made known. The 1982 budget from OMB was something like $40 million.

At that point, I decided that I had better take President Reagan's advice and join the private sector and see if I could not help the photovoltaic industry outside of the Government, because it was clear that the Government support was gone.

Fortunately, the Congress added about $20 million to $25 million to the OMB request, and we did end up with about a $70 million budget in fiscal 1982, down from $160 million.

Today, I would like to comment on four factors with respect to that budget reduction. I would like to give a quick overview of the impact of the reduced budget on the cost reduction goals of the Department of Energy's program plan, the impact on the health of the industry in general, and the impact on small business in particular.

In closing, I will discuss our international position in photovoltaics and attempt to define some opportunities for further Government support.

As you know, the research-for-research's-sake edict of the Office of Management and Budget was not only a budget reduction but a complete change of course with respect to how the Government PV funds would be spent. That edict resulted in roughly $20 million worth of contract effort in the silicon cost reduction area being terminated. Primarily this effort was in small concerns.

Mr. Chairman, you visited some of those companies in Massachusetts. One of the companies, of course, was the company next to me, Roger Little's company, Spire. That $20 million withdrawal from the silicon cost reduction effort accomplished two things. It essentially terminated several key innovations, possibly forever, and it also delayed the possibility of PV being cost-effective in the world market. I do not fault the Department of Energy for making this change. They had to make a change to go from $160 million to a budget that was roughly $60 million, but they were told and ordered by the Office of Management and Budget to go to high-risk long-range research-for-research's-sake, and they were specifically required to terminate the near-term silicon-based research.

This termination impacted primarily on small business. I think it would be worthwhile to list for the record those innovations which were terminated by the withdrawal of DOE from the silicon cost-reduction effort.

The first innovation that was lost is the reduction in the price of the raw material, the polysilicon. The project with Union Carbide was terminated. The reduction in the cost of slicing silicon was terminated.

The role of ingot casting so as to make semi-crystal material or crystals by casting rather than pulling was slowed down or terminated at two companies.

The automated manufacture using lasers, ion beams, or electron beams was terminated.

The high-speed dendritic web program at Westinghouse was dramatically curtailed.

The advanced ribbon technology in two or three small companies was either cut in half or terminated.

Finally, the research on thin film silicon was stopped at a very critical phase when they were ready for process technology and production experience.

We were at the verge of half a dozen significant factory accomplishments in the research laboratories of our companies throughout the land when these projects were terminated.

The private sector did respond with continuation of many of these projects in those companies which have gained their money from oil companies' support. I applaud the oil companies for continuing this high-risk research.

For example, the ribbon work at Mobil Solar Energy has continued, and actually they have indicated that they do not need additional funds from the DOE. A large amount of the research that I have been describing will continue.

But virtually all of the research in the small business arena has been discontinued and these companies are having very difficult times finding venture capital. I personally assisted over six companies in trying to obtain venture capital, and to this date we have not received a penny. A couple of the companies are looking forward to the possibility of some money early in January of this year.

In our international arena, we still sell roughly 70 percent of the international opportunities. There is an international market of roughly 6 megawatts this year; the United States serves roughly 70 percent of that market.

I have attached a paper which I gave at the IEEE meeting in August in San Diego. In that paper I forecast that the U.S. market share will be less than that of Japan by 1990.

That forecast is less dramatic than some headlines that have been made in recent months with respect to the Japanese photovoltaic endeavor. I spent the month of May in Japan, visiting most of the companies, and I found several major concerns in the Japanese industry which had products of absolute quality. So they are being very careful not to introduce poor quality products into the marketplace prematurely. So, despite the headlines that we read about Sanyo or Fuji in Japan, it is my forecast that the Japanese will enter the terrestrial photovoltaic market, for use of reasonable power-sized generators, in the late 1984 time frame and not before then. So, we still have a couple of years before Japan is a major threat.

They also are very sensitive to the role that they have played in the world market in such things as steel and automobiles, and it is my forecast that the Japanese industry will be very likely to license their technology if indeed it is sufficiently advanced for U.S. manufacture and sale to a U.S. company.

I think that is something that they are very aware of in the photovoltaic industry; that they do not want to create another defensive position in this energy commodity-like market arena. They are going to be competing with us primarily in the developing world. Now, they compete with us in the developing world in an incredible way.

A Japanese contingent never seems to have less than four or five persons, whereas the average American small company has a hard time scraping up funds to send one person to the international meeting, and wherever you go in the international community with respect to energy, you will see large groups from the Japanese companies.

They come armed with tremendous amounts of samples. In fact, in many countries the Japanese have given complete free systems to the host country for them to see how photovoltaics works. In the United States, we have a relatively underfunded group of small entrepreneurs trying to scrape together enough money to get a ticket to go to the trade show that the Commerce Department puts on, and when we get there, in many cases the prework has been inadequate, and the contacts are not made, and sales are not made, and the American industry comes up short.

Now, there can be a very successful relationship between our Government and the small business in international trade, and we can discuss that in more detail later. I propose PV marketing grants to small PV businesses. These grants of $100,000, should be awarded to the best market development plans for a specific product in a particular country. The company should then be required to report sales made to the Government. These grants coupled with well-planned trade shows can dramatically impact U.S. sales.

I think the key issue confronting this committee is not whether the U.S. photovoltaic program is adequate, because that is a bigger story, but whether the photovoltaic program is serving the entrepreneurial companies that are the vital element in making the photovoltaic industry obtain its cost goals and product performance and whether or not we are supporting these companies in this rather difficult international market. My feeling, Mr. Chairman, is that we have abandoned these companies.

My comments address that in more detail, Mr. Chairman.

[Mr. Maycock's prepared statement and attachments follow:]

PREPARED STATEMENT OF PAUL D. MAYCOCK, PRESIDENT, PHOTOVOLTAIC ENERGY SYSTEMS, INC., ALEXANDRIA, VA.

When Congressman Bedell asked me to participate in this hearing, I was reluctant for fear that my comments might be considered "sour grapes." I was managing the Nation's PV program for DOE in January 1981, with a $160 million, well balanced, RDT&E effort when the OMB call for 1982 budgets in PV was made known. It was clear that the new administration was out to eliminate the PV budget and go back to a "research-for-research's-sake" $20 to $30 million a year budget. I immediately decided to leave my career SES position in DOE rather than manage a "sinking ship." After nearly 2 years in the private PV sector, working as a management consultant to the PV industry, publishing a monthly newsletter (PV News), lecturing throughout the free world on PV, and helping Congress to discover PV, my perspective on the impact of the drastic budget cuts in mellowed by time and progress in my field. My comments on the Federal role in PV will be divided into four key areas: Impact of reduced budgets on DOE cost reduction goals; impact on the health of the industry; impact on small business, and our international position in PV.

Impact on reduced DOE PV budgets

The Congress has added significant funds to the administration proposed fiscal year 1982 and 1983 budgets. The $150 million appropriated in fiscal year 1981 was cut to about $70 million in 1982 and fiscal year 1983 will be about $50 to $60 million despite the administration's request for $27 million. The "research-for-research's-sake" edict from OMB has forced the DOE to reduce or terminate all effort aimed at the PV module cost reduction goals for 1986 that were so carefully developed by DOE and the Congress in the PV-RD&D Act of 1978. The key goal of PV module prices of $.70 per watt (1980 dollars) in 1986 will not be met. Attached is a recent paper where I forecast PV module prices to 1990. PV modules will sell for $2 per watt in 1982 dollars in 1990 with the $.70 per watt level being met in 1995-2000.

One cannot exclusively blame the decreased DOE funds for this 10-year delay. The cost reduction results in the laboratories funded by DOE are taking 3-5 years longer than planned to transfer to production and gain the resultant product price reduction. These delays are not only due to DOE funding cuts. They are also caused by the lack of preproduction risk capital in those companies that were dependent primarily on DOE funds. Several large and small companies have slowed their PV programs as a result of the premature DOE pull out.

Impact on the health of the industry

A key measure of the health of an industry is the amount of risk capital available. The oil company funded PV ventures have had increased risk capital since the DOE withdrawal. These oil funded companies include Solarex, Arco-Solar, Solar Power, ECD, and Mobil Solar. These companies account for about 70 percent of the world PV module sales in 1982.

The PV world market is growing, but U.S. dominance will stop. We estimate world module sales at 8-9MW in 1982 with a retail value of $120 million. (Note: This does not include about $25 million sales of calculator and watch PV power packs by Japanese firms.) The world PV module market is up 60 to 80 percent over 1981. DOE withdrawal has not seriously impacted the market. Factory prices to distributors are now $7-8/Wp and clearly, a long way from the DOE (1980 dollars) $2.80/Wp goal for 1982. The PV module market appears to be much larger at a much higher module price than the DOE anticipated. In the United States this is due to tax credits and third party finance rules for grid-connected systems. The tax credits are vital to PV market growth in the United States. The PV market is also enjoying strong interest from people concerned with noise, their desire for energy independence, and the remarkable reliability of the PV systems. The large oil company funded companies are doing well, but the small companies are suffering.

Impact on small business

The small business story is completely different than the oil funded PV ventures. The premature termination of DOE funds for systems research and silicon module cost reduction research have left dozens of small PV firms with inadequate DOE funds and no risk capital to carry the task to completion. Some of the innovations lost due to DOE withdrawal include reduction in the price of polysilicon; low cost slicing; ingot casting; automated manufacture using laser, ion or electron beams; high speed dendritic web; advanced ribbon technology; and thin film silicon.

All of these efforts are floundering with little or no private capital to be found. The DOE got out about 2 years too early. The small PV companies in cell research, product development, cost reduction are virtually wiped out owing to the DOE "on-again, off-again" budgets. We feel at least $20 million per year is needed to salvage these silicon cost reduction innovations.

Our international position in PV

The U.S. firms presently make and sell about 70 percent of the PV modules in the free world. The Europeans have about 10 percent now and are expanding capacity. Europe will grow to about 20 percent of the world market by 1990. The fastest growth is from Japan with about 20 percent of the world market now. We forecast 35-35 percent market share by 1990. The U.S. share will drop to 30-35 percent by 1990. We have just completed an exhaustive analysis of PV in Japan and published a monograph, "America Challenged: Photovoltaics in Japan." Our key conclusions are: Japanese PV technology is now equal to the U.S.; Japanese production experience is 2 years behind the U.S. in single crystal silicon and 1 year ahead of the U.S. in amorphous silicon area; the Japanese will introduce competitively priced amorphous silicon modules into the terrestrial market by late 1984, and the Japanese will have a market share equal to the U.S. by 1990. Our small U.S. PV firms need assistance in the international market arena. Their R&D funds are greatly reduced and the DOE international program in PV is nearly zero. The United States PV program created the industry starting in 1974. As we grow to a multi-billion dollar industry by 1990, we stand a very high probability of loosing out to the well planned, adequately funded Japanese industry-government coalition. Meanwhile, in the U.S., we turn off the PV program and tell the industry, "you've been so successful, do it on your own."

Mr. Chairman, I've tried to be as specific as possible in addressing your concerns as to an appropriate Federal role for PV.

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PHOTOVOLTAIC TECHNOLOGY PROGRESS AND MARKET OUTLOOK

Paul D. Maycock
Photovoltaic Energy Systems, Inc.
2401 Childs La., Alexandria, VA 22308

Edward N. Stirewalt
Planning Research Corporation
762 Monroe St., Herndon, VA 22076

ABSTRACT

A detailed summary of the major technical options for Photovoltaic cells are present. Key conclusions are:

- Single crystal Czochralski silicon cells will have 30-40% of the world market by 1990.
- One half of the single crystal cells will be sold for concentrators.
- Semicrystalline silicon cells will serve at least 25% of the world market in 1990.
- Ribbon and/or thin film silicon will serve about 15-20% of the world market in 1990.
- Amorphous silicon can serve 15-20% of the 1990 market.
- No compound semiconductor will have more than 5% of the world market.

The average prices for 1984 are forecast to be $6 per Watt (1982$). The module prices for 1986 are forecast to be $4/Watt (1982$), and by 1990 average prices of $3/Watt are expected. A market of 100MW in 1986 and over 500MW in 1990 is forecast. The total market, size of key segments and prices to 1990 will be presented.

INTRODUCTION

The authors have completed a detailed, Technology and Market Forecast for Photovoltaics from now to 1990. The topics covered include:

- Cell technology and its impact on product performance.
- Module and system cost reduction forecasts.
- Analysis of the market and forecast for all key segments to 1990.

The purpose of this paper is to highlight the findings of this analysis.

TECHNOLOGY ANALYSIS/FORECAST

A detailed technology forecast for the major cell production options was made for the research phase, the process development phase and the product production and testing phase. Each option was costed out for a PV module that could be deployed with a package that provided adequate reliability to permit a 5 year warranty. It became very clear that the silicon options provided a higher probability of reduced cost, superior performance, and demonstrated life. A new non-silicon cell would have a very difficult market entry unless the cost reduction for the silicon options was not realized or the new option had greatly increased efficiency at a competitive price.

Price reduction forecasts were made starting with the present $6.50 to $8.00 factory prices for single crystal and semicrystal modules with 5 year warranties. First, we determined that these prices for modules made with the present production processes and equipment can be profitable if 5% is allowed for research and 10% of sales for marketing.

All specific cost reduction options for the five silicon technologies were quantified and a product/performance matrix - shown in Table 1 was developed. Time to go from research feasibility to production reality for the cost reduction action was estimated.

The major conclusions of the technology forecast and analysis are as follows:

- Single crystal silicon solar cells will continue to dominate the world market with a 30-40% share in 1990. Key factors will involve lower cost silicon ($40/kg), larger cells, multiple pulling from the melt-replenished crucible, faster sawing with more slices per inch, high yield at 15% efficiency, and automated production. Modules from single crystal cells will be 15% efficient and sell for $3/Watt (1982$) in 1990.

- Concentrators using single crystal silicon cells will gain 20% of the world market by 1990. This penetration will be contained within the single crystal cells 30-40% market share. Concentrators can be 20% efficient by 1990 and sold for $2/Wp.

- Polysilicon slices (SEMIX, SILSO) will gain 25% of the world market by 1990. Low cost silicon costing less than $10/kg will be used and 14% modules will be made. Module prices in 1990 can be $2/Watt. Lower efficiency than single crystal modules and product life issues will limit market penetration.

- Sheet silicon (ribbon) will gain 15-20% of the world market by 1990. The throughput limit of EFG or Dendrites will be broken by a new high-speed growth process that results in polycrystal cells. The sheet technology area will be 3 years behind the slice options in market acceptance and cost reduction until 1988 when they catch up. Sheet modules at 12% efficiency will be priced at $3/Wp in 1990.

- Amorphous and Thin Films of silicon can gain a market share of 15-20% by 1990. Both of these products are capable of very low cell cost. They will be slowed by low efficiency (6-8% in 1985), unproven reliability and difficult, low area yield process development. These film options will be 10% efficient and sell for $2/Wp in 1990.

- A non-silicon option can obtain 5% of the world market by 1990. The favorites at the moment are cadmium telluride and copper indium diselenide. The electro-chemical, luminescent and other "new" approaches are not likely to gain product status by 1990. Fundamental failure mechanisms in very thin films will adversely affect market acceptance.

One can show that the process to make thin film or amorphous silicon cells or a new thin film cell results in cell costs of a few cents per Watt, provided efficiencies of 6% or greater are obtained. This analysis assumed the price of a module included cell costs, a hermetic package, a 5 year warranty, marketing costs at 10% of sales, R&D at 5% of sales and a reasonable profit for the company. When one considers the cell cost reduction in the light of these additional costs, it is difficult to forecast amorphous silicon or thin film module prices below $2 per Watt (1982$) in 1990. Integration of films into transparent structures like 2-pane or 3-pane glass curtain wall can greatly reduce price. The key to very low cost film modules is to integrate with the building skin. If this is done, by 1990, $1/ Watt prices are possible. We did not consider the probability of this occurring high enough to include in our forecast. Table II is the module and component price forecast used as a basis for development of the market forecast. We will not discuss the balance of systems cost reduction as these are considered virtually certain.

KEY MARKET SEGMENTS

The world PV market was developed by taking each segment and forecasting saturation levels at the forecast prices of Table II. The potential and time required to increase capacity with lower prices was quantified and found to be the limiting factor in PV sales growth after 1983. When PV systems become fully economic as fuel savers for diesel and gasoline powered generators, (1985), explosive growth in the market was possible. The key segments used in this analysis were based primarily on the nature of the storage required by the application.

- Remote or portable battery chargers (the product already has storage) This includes communication, portable electronics, signals, consumer products. We forecast this market to saturate at 50MW/year by 1988 (primarily consumer products).
- The product is the storage market - These applications include water pumping-purifying, refrigeration, daytime loads, cathodic protection. This market will saturate at 100-200MW/year by 1990.
- The diesel fuel displacement market (fuel is storage) This applicaton uses diesel or gasoline motors or generators as backup, and provides either torque or electricity. The key is a reliable transition from PV to diesel to PV without loss of load. This market will saturate at 200-500MW in 1995.
- The Utility-connected market (the grid acts as storage) This includes grid-connected houses and small, less than 50MW, generation systems.

  Grid-connected houses will start in the U.S. and probably nowhere else because of the 40-70% federal and state Tax Credits. U.S. small third party ownership projects for central power will be the first to come on line. The market depends heavily on tax credits. It could easily be 500-1000MW/year by 1990 if tax credits are extended.
- Central Power Generation - 25% Capacity Factor - no special tax treatment, 100MW or more. These fully central options will not be economic before 1995.

MARKET FORECAST TO 1990

The study reviewed and summarized all market research to date. Each market segment was characterized by the total number of potential users, the break-even economics of each application, the role of other owner benefits in market acceptance, institutional barriers, and PV module supply limits. A composite forecast was developed as shown in Table III. Table IV compares this forecast with those of other analysts. Our forecast is very similar to that of Strategies Unlimited, which is proprietary.

The PV market is a very exciting opportunity that will only be realized if the cost reduction and performance levels forecast are reached.

CONCLUSIONS

The Photovoltaic option will enjoy a decade of product change - three (or four) generations in ten years - and will make steady market growth to a billion dollar systems industry by 1987 and a billion dollars in module sales by 1988. Obviously a forecast such as this can hold only if the many assumptions about technology change, price reduction, price of competing fuels, etc., are nearly correct. The authors feel the forecast is conservative and expect that virtually all "surprises" will lead to lower prices, better performance and more rapid market acceptance. The forecast will be continuously tested and modified as new entrants, products and prices are fact. Readers' comments, criticism and questions will be answered promptly and thoroughly.

TABLE I

OVERVIEW FORECAST FOR KEY SILICON BASED OPTIONS

Module Prices Possible (1982$/Watt)

Option	1982 Price	Eff.	1985 Price	Eff.	1990 Price	Eff.
Single Crystal Si	$ 10.00	10%	$5.00	13%	$3.00	15%
Semi Crystal	10.00	10%	4.00	12%	2.00	14%
Ribbon	10.00	10%	6.00	11%	3.00	14%
Concentrators	7.00	12%	4.00	15%	2.00	20%
Amorphous Si	20.00	6%	4.00	8%	2.00 or less	10%

TABLE II

MODULE AND COMPONENT PRICE FORECAST

	82	86	90
Module $/Wp (5 year warranty)	10	4	3
Battery $/kW hour (capacity with 3000 deep cycles)	150	120	100
Installed frame $/Wp (roof)	2	1	.50
Installed/Racks (land)	5	2	1
Regulator (DC small) ($/Wp)	.20	.10	.05
Inverter DC/AC (< 10kW)($/Wp) (grid-connected, 5 year warranty)	.70	.50	.30
Central Power Conditioning($/Wp)(> .5MWp)	.70	.40	.20

TABLE III

FACTORY PRICES - 1982$

	1981	1982	1983	1984	1985	1986	1990
MWp	6	9	15	30	60	100	500
$/Wp	11	10	8	6	5	4	3
$ (M)	66	90	120	180	300	400	1500

Assumes $40kg Polysilicon by 1985

TABLE IV

COMPARISON OF PV WORLD SALES/MEGAWATTS

	1982	1986	1990
BDM	30	140	-
ITC	20	300	-
SERI	25	700	2500
MONEGON	14	500	8000
MAYCOCK/STIREWALT	12*	100	500

* Includes 2MW of consumer calculators, watches, radio chargers.

TABLE V

PHOTOVOLTAIC COMMERCIAL MARKET SALES

by Market Sector

	1981	1982	1983	1984	1985	1986	1990
Commercial Sales (MWp) (non government)	4.5	7.2	12.8	27	54	90	450
Communication % (Radio, TV)	35	30	25	20	20	15	10
Water Pumping, Refrigeration, Desalination	25	25	22	22	20	18	15
Remote Residences (10kWp) (%)	15	18	20	20	20	20	20
Consumer Products (%)	10	10	8	8	8	7	5
Grid-Connected Central and Distributed (%)	10	10	15	15	15	15	20
Cathodic Protection (%)	5	5	5	5	5	5	5
Remote Village (Diesel, 1MWp)(%)	0	2	5	10	12	20	25

Mr. **Bedell**. Thank you very much, Mr. Maycock.

Mr. Little.

TESTIMONY OF ROGER G. LITTLE, PRESIDENT, SPIRE CORP., BEDFORD, MASS.

Mr. **Little**. Mr. Chairman, ladies and gentlemen, my name is Roger Little. I am the president of Spire Corp. in Massachusetts. We are a small innovative company that develops advanced processing equipment to manufacture photovoltaic cells and modules.

Our perception is that today the U.S. photovoltaic industry is fragile. No one in the industry is profitable. There are few public dollars ready for investment because the payout times are too long. Private support is principally by the oil industry. Today's oil industry is not favorable to PV. Aggressive foreign competition is growing rapidly. Government involvement is necessary if we are going to survive, grow, and prosper.

To be profitable, photovoltaic module costs must come down. As costs come down, the markets open up exponentially. In 1973, costs were about $80 a watt. Today, they are about $10 a watt. This has been achieved primarily through technical innovation. That has really been America's strength: Reducing costs through technical innovation. Much of the innovation has been due to Department of Energy programs.

Now, with the budget cutbacks, the industry is weakened, especially small businesses. Small businesses are truly on a path of extinction.

As prices come down, markets open up overseas, and that has initiated a lot of international competition, primarily from the Japanese and Europeans, although now the Saudis are moving in and considering production. It is tough competition, and these other countries are providing support to help their industry get started.

Eventually, for the market to swing back from international markets to a U.S. grid-type market, a lot needs to be done. The efficiencies of modules have to be increased at least a factor of two, and costs must come down, perhaps, an order of magnitude. This requires innovation. With the DOE cutbacks there is very little innovation, especially among small businesses, which are perhaps the largest contributors to innovation.

Also, since small businesses don't have the resources to compete in the international arena. As a result, small businesses have become technology salesmen to the international photovoltaic industry. In other words, we are selling our technologies in order to survive the present business climate. What is happening is, we are rapidly transferring the U.S. technical edge overseas, and this further undermines the future of the U.S. photovoltaic industry. We need further participation by the Government, principally because it takes so long to get an innovative idea through the development cycle and into production. It can take as long as 20 years. No industry will support that unless it is profitable; our industry is not.

It may have been possible for small businesses to have addressed a small market of a higher-priced product and have bootstrapped their way into larger volume production in a competitive position, but there have been problems associated with products being sold at perhaps below cost. This has been due in part to energy company involvement along with the associated Government cutbacks.

I think small businesses appreciate oil company participation; it is necessary. In the long term, it is going to take a lot of resources. There is a lot of capital required in order to get into large-scale production.

One of the problems that has been caused, has been that the position of the major oil companies involved in this area has been that they need no Federal support, but the technology is ready for commercialization; that has had a major effect on the recommendation that the budget be $27 million by the administration in 1983.

It is much too small for small businesses to survive.

In summary, I feel that photovoltaics is a rapidly growing renewable energy business with a predominantly international market that has unlimited potential, but that the U.S. position is precarious.

First of all, it appears that the oil companies are losing interest in PV and pulling back their efforts because of the worldwide oil glut, reduced profits, and modest near-term markets.

Second, small businesses are in trouble. They have no market for their product because of the relatively high cost, and the broad international competition. They have no resources to pursue cost-cutting technology because of DOE cutbacks; little investment is available.

Third, in order to survive, we are selling our technology overseas, and that is helping to create some very strong technologically advanced international competition. These factors will result in a decrease in U.S. participation in the international PV market.

Specifically, I would recommend that the DOE budget be increased substantially. I know that there has been much discussion about this in the past, but I do not feel that we should lose sight of the role that DOE played, and we must continue to push in the directions they initially established.

Substantially higher budgeting than what the administration has targeted is necessary—at least $58 million that the Senate has recommended—and preferably without the Smud project.

I think it is also necessary to pass the renewable energy incentives bill and support PURPA. These things will eventually cause the markets to swing back to the United States.

Thank you.

[Mr. Little's prepared statement follows:]

PREPARED STATEMENT OF ROGER G. LITTLE, PRESIDENT, SPIRE CORP., BEDFORD, MASS.

I. INTRODUCTION

Photovoltaics, PV, is unique in that it has near-term markets as an exporting high technology industry while offering the possibility of major U.S. energy impact in the longer term. An industry which is profitable in the near-term markets is more likely to succeed in achieving the longer term national goals. However, today the photovoltaic industry is fragile with no one profitable, in the free market sense. There are few public investment dollars available for small business in renewable energy. Private support is principally by the oil industry and today's oil industry climate is not favorable to PV. Aggressive foreign competition is growing rapidly. Government involvement is therefore necessary if the industry is to survive, grow and ultimately prosper.

Photovoltaic technology progress, with associated cost reduction, has been made in good part due to Department of Energy programs. Recent budget cutbacks have resulted in a weakened U.S. PV industry, especially small businesses which are on the path to extinction in the face of strong national and international competition.

II. APPROACH TO MARKET PENETRATION

As costs are reduced, PV markets open up almost exponentially. Photovoltaic module cost reductions from 1973's $80 per watt to today's $10 per watt have been achieved principally through technical innovation and engineering development. This has been American industries' strength—market penetration through cost reduction due to technical innovation.

As photovoltaic module prices have come down, the markets that have opened up have been principally overseas, in developing nations, due to their higher energy costs and lack of grid power. This near-term market direction has stimulated much international competition. The Japanese and Europeans have become especially aggressive about PV. The Japanese industry, which is evolving rapidly, is dominated by semiconductor manufacturers. The Japanese semiconductor manufacturers are drawing parallels to their successful entrance into the semiconductor industry when U.S. manufacturers dropped their guard during the 1974 recession. Japanese investment in 1982, especially by government, is comparable to ours. PV has been targeted by the Japanese as a major high technology product in their export industry. Now Saudi Arabia and other Mideastern countries are entering the market.

For the market to swing back to the U.S. grid, much more needs to be done. The utilities' Electric Power Research Institute has performed analyses which indicate that 15 to 16 percent efficient modules are needed for the grid power. In order to achieve utility application, we must reduce the cost of modules a factor of 10, increase their efficiency a factor of two, and increase their lifetime a factor of three. Approximately $400 million has been invested in photovoltaics since the DOE program began. It has been estimated that it would take another $400 million to achieve utility goals. A typical industry today does not invest more than 10 percent of its gross revenues in R&D. This would require a $5 billion photovoltaic industry, which is a long way from the current $100M industry level.

With DOE cutbacks, innovation is dwindling especially because small PV businesses, perhaps the largest contributors to innovation, are having difficulty surviving. Also, since small businesses do not have the resources to compete in the international arena, and are struggling to survive these government cutbacks, most have become "technology" salesmen, rapidly transferring the U.S. technical edge overseas. This further undermines the future of the U.S. PV industry.

III. U.S. INDUSTRY STATUS

The argument for continued Federal participation is based upon a perception of the time required for PV product growth stages in the energy industry. Once an innovative approach to cost reduction is identified, it takes as long as 15 or 20 years to bring that concept from advanced research through technology development to pilot production; then small scale production and finally, up the learning curve into large volume production. Few industries have the resources to sustain new technology through this growth cycle, especially without profitability.

Although such a product growth evolution may have been achieved by small business with government supported innovation and small and intermediate size, higher-priced product markets, major energy company involvement in these early markets and associated government cutbacks have made this nearly impossible.

In the period of oil company windfall profits, investment if photovoltaics became fashionable. Although oil company participation is welcome and necessary in the long term, because of the capital intensive nature of PV manufacturing in large scale, in the short term it has been detrimental. The effects have been: to intimidate investors and other less than oil company size industries away from PV; to sustain artificially low PV product prices; and to convince Federal officials that PV was ready for "commercialization" and therefore no longer in need of DOE participation. The latter recommendation has been a major factor in the reduction of the DOE photovoltaic budget from $151M in 1980 to a possible $27M in 1983, as requested by the administration.

IV. SMALL BUSINESS STATUS AND THE U.S. LONG-TERM PV MARKET POSITION

PV is a rapidly growing renewable energy business with a predominantly international market that has unlimited potential. The U.S. position in that market is at best precarious. The oil companies are losing interest in PV and pulling back their efforts because of the worldwide oil glut with associated profit reduction, and the modest near-term market size.

Small businesses find that they have no market for their product because of its relatively high cost and "buy-in" national and international competition. Small companies have no resources to pursue cost reducing technology because of DOE cutbacks. Little investment is available because of the relatively long payback time for investors and dominance of the market by energy companies. In order to survive, small businesses are selling their technology overseas, helping to establish strong, technologically advanced, international competition. These factors will result in a rapid decrease of U.S industry participation in the international PV market.

V. SPECIFIC RECOMMENDATIONS

The DOE PV budget must be increased dramatically to sustain this industry. A $27M budget will insure the demise of small business participation in PV and, perhaps, eventually our nation's. A substantially higher budget of at least $90M in 1983 is required.

Mr. BEDELL. I thank you, Mr. Little. I yield to Mr. Hiler.

Mr. HILER. Mr. Maycock, how much dollar support do you think the Federal Government should put into total energy development?

Mr. MAYCOCK. Total energy, or photovoltaic energy development?

Mr. HILER. Total energy development.

Mr. MAYCOCK. I am not qualified to answer that, Congressman. My business is photovoltaics, and I don't really understand all of the options in that degree.

I think that if the $5 billion order of magnitude budget that the DOE has been used to spending were appropriately managed and appropriately allocated, they could make a major impact in the area of energy, in particular. My area of expertise is photovoltaics, so I would rather not try to conjecture beyond that.

Mr. HILER. What do you think of the Clinch River breeder reactor program?

Mr. MAYCOCK. The breeder technology is a very important technology in the future of energy. It does represent one option for the nuclear community that makes a lot of sense. Unfortunately, the technology base of the breeder at Clinch River is about 10 years old and, in my opinion, it is a waste of our taxpayers money.

If we have to have a breeder program, we at least ought to do a breeder that is up with the French technology.

Mr. HILER. So, would you say that in terms of domestic energy production, do you think photovoltaics offers greater potential over the long-term energy needs of this country than the Clinch River, or about the same, or marginally less, or substantially less?

Mr. MAYCOCK. We are specifically talking about the Clinch River breeder as presently constituted. Is that correct?

Mr. HILER. Well——

Mr. MAYCOCK. Because I do not want to go on record as saying that the breeder technology is wrong. What I am saying is that this specific expenditure of the order of magnitude of a few billion dollars.

Mr. HILER. A couple billion dollars?

Mr. MAYCOCK. Right. This specific expenditure of $2 billion, I think, is incorrectly applied as compared to the benefits of $2 billion put on photovoltaics.

Mr. HILER. What are your feelings about the $17 billion that is appropriated or authorized for the Synfuels Corps?

Mr. MAYCOCK. I just have no knowledge to comment on that, Mr. Hiler.

Mr. HILER. What I am trying to get at——

Mr. MAYCOCK. I understand that you can change the mix.

Mr. HILER. Scarce resources in changing the mix, and I just wonder if we stand a better chance of helping our own domestic economy through increased exports, which I understand from the limited amount of understanding that I have of photovoltaics, that is where the ultimate good is going to come from photovoltaics. I just wonder if we would not be further ahead spending these billions of dollars in something like photovoltaics, where the infusion of $1 billion over 3 or 4 years might lead to dramatic improvements in technology and cost structure.

Mr. MAYCOCK. Mr. Hiler, I know the Congress did pass such an act; it is called the Photovoltaics R&D Act of 1978, and it called for, if I remember correctly, the order of magnitude of $1½ billion and, at the moment, DOE is essentially in violation of that act.

Mr. HILER. I have no further questions.

Mr. BEDELL. I thank you very much, Mr. Hiler. I think you have hit on some of the questions, some of the issues, that we would like to pursue at this hearing.

We have just had a call for a vote. I will try to complete my questioning in 5 minutes. I think you have hit upon in your testimony, Mr. Maycock, the short term opportunities for photovoltaics that will exist in the developing world. Could you elaborate?

Mr. MAYCOCK. It is at the moment, although the U.S. market is growing much faster than most of us anticipated, Congressman, in that the people who do not have electricity are, first of all, surprising in number. There are over 5,000 photovoltaic residences in remote parts of the United States that we would not have planned years ago in our market forecast. Roughly a megawatt of photovoltaics was sold in the United States to applications that we would not have envisioned.

The other area is that with the Public Utility Regulatory Policy Act, and the third-party financing rules that new tax law provides, there have been several megawatts, exactly 6 megawatts, started under the aegis of third-party financing for central applications in the United States.

So, very fortunately for U.S. industry, the American market is growing much faster than anticipated. It is still true that the major market opportunity without tax credits exists in the developing countries as we compete with the diesel-powered electrical generators throughout the world.

Mr. BEDELL. What could our Government do to help small companies in the photovoltaics industry compete more effectively in the international marketplace?

Mr. MAYCOCK. I worked with our international section in DOE on this at length. The difficulty we have in trying to help a small company is that we generally make them compete for the money.

We generally make them write all kinds of reports for the money, and we overmanage them. What I proposed was that we pick 20 to 30 companies and get them on a qualified bidder's list, and then give them a grant for an international market program, and all we ask of them after spending the moneys, to tell us how much they sold, and those who sold more were then in line for more support.

We must simplify our Federal support of small business. If you take a small 8- to 10-person company and you have to write a $30,000 proposal to the Government in order to get a $30,000 assistance, it is just not good business; so we have to have a simple grant process to help this.

Mr. BEDELL. Mr. Little, as I understand, your company is involved in helping other companies automate in regard to production. Is that what you are doing?

Mr. LITTLE. That is correct.

Mr. BEDELL. You were with the Department of Energy, were you?

Mr. LITTLE. No, we receive support from the Department of Energy.

Mr. BEDELL. You never did work for the Department of Energy?

Mr. LITTLE. No, sir.

Mr. BEDELL. Do you feel you have been treated fairly by the Department of Energy?

Mr. LITTLE. Yes, sir.

Mr. BEDELL. What could they do to better help small companies in the photovoltaics industry?

Mr. LITTLE. I thought the program that was in effect a couple of years ago was helping me as well as big companies, medium-size companies, and other small companies, was a program which addressed basic research, technology development, and evaluation demonstrations of systems, and so forth. I think that this helped the entire industry.

Mr. BEDELL. Has that been continued now?

Mr. LITTLE. No, it has essentially been chopped back from the systems area, back through technology development, and what remains is advanced research and development, which is fine, except it won't help us in the short term.

Mr. BEDELL. Mr. Maycock, you were in Japan recently?

Mr. MAYCOCK. Yes, sir.

Mr. BEDELL. I take it that from your testimony that you do not see Japan as great a threat as some people might expect. Is that accurate?

Mr. MAYCOCK. I don't think it is as great a threat as the recent headlines might indicate, Mr. Chairman. I think headlines tend to do that. There is absolutely no doubt in my mind that by 1990, the Japanese will have a larger market share in the world's photovoltaic market than the United States That is only 8 years from now.

Mr. BEDELL. Regardless of what we do?

Mr. MAYCOCK. Yes, sir, regardless of what we do.

Mr. BEDELL. I would like to pursue that further, but we have a vote on the House floor. If it is agreeable with Mr. Hiler, we will release these witnesses, and go vote. We will be in recess for about 10 or 15 minutes.

[A short recess was taken.]

Mr. BEDELL. The subcommittee will come back to order.

Since you are still here, Mr. Maycock, I was quite intrigued by your last statement which was the Japanese were going to beat us no matter what we do.

Mr. MAYCOCK. That isn't quite what I said, Congressman. Your question was, could we do anything to forestall the Japanese dominance by 1990. My reaction was that we probably cannot, and the reason we cannot is that we have lost roughly 2 years of critical momentum, and the U.S. Government program is no longer credible in the world with respect to photovoltaics. We were the leading most credible program in the world 2 years ago, and we are no longer believed.

And so, if we start saying we are going to start doing something about it, how long is it before we can accomplish that? Probably a year or a year-and-a-half. So if you take the 1990 timeframe, it is going to be extraordinarily difficult to change the momentum by starting in fiscal year 1984. The damage has been done, and we will probably have to live with a rather strong threat from the Japanese.

The other part is that they were coming all along despite all of our support. When we were at $160 million they were growing their budget each year, too. So, the Japanese have picked this as an area for major technological innovation.

They have their best people working on it in their largest companies. The number of professionals working in photovoltaics in Japan is about the same as it is in the United States right now. It is going to be very difficult to overcome that momentum. I don't think we can just throw another $20 million at photovoltaics, and hope that we will keep the Japanese out. I don't think it is going to be that easy.

Mr. BEDELL. I don't think anybody was suggesting that, but if we are whipped we are whipped, and I suppose we might as well admit it. I don't perceive you to be saying that.

Mr. MAYCOCK. We are not whipped and are going to stay very competitive with the Japanese at least through 1990.

Mr. BEDELL. Is it going to matter how much effort we put into the projects? One of the arguments I have been making is that it is terrible for our Government to decide that we are not going to compete directly with what other countries are doing in new photovoltaic technologies which show great promise.

Mr. MAYCOCK. I think we can turn the momentum around, and as we go into 1990 we can have the U.S. industry gaining market share instead of losing market share, but I don't think we can retain the dominance that we have today.

Mr. BEDELL. What would we need to do to increase our market share? Is there a place for the Government to assist, or is it better to leave it to the industry? There is a good chance that this new technology could develop a sizable market both internationally and domestically. Is that correct?

Mr. MAYCOCK. Yes, sir.

Mr. BEDELL. It is a growing market rather than a declining market?

Mr. MAYCOCK. Yes.

Mr. BEDELL. Then it should be of interest to us as a nation to have as much of that market as possible. How can we accomplish this?

Mr. MAYCOCK. If I were trying to assist U.S. industry right now, I would make absolutely sure that the funds were allocated to those programs that had cost reduction and performance impact in the next 3 years, and I would shorten the planning horizon for Government expenditure of funds, and I would take the list of innovations in my testimony and figure out how to make those a reality in a U.S. firm.

Mr. BEDELL. If I understand correctly, the present policies of the administration and of the Department of Energy are that it is wrong for the Government to help with anything that is already commercially proven or commercially viable.

In other words, we should only get involved with basic research rather than help industry to become more competitive.

I think that is a fair assessment of the current policy.

Mr. MAYCOCK. I think you could ask the Department of Energy what their current policy is. It is my impression that the OMB guidance is you only do high-risk long-term research. The issue that I think is before us is not is something commercial, but the question is, can something close enough to commercial to be a good investment by private sector risk capital.

So it is a question of timing. Private sector risk capital wants to have a return in the next 2 to 3 years. Those things that are 3 or 4 years out are very difficult to get funded. It is that area that I am talking about. Those things which have commercial viability 3 to 4 years from now we have stopped funding under the present guidance that OMB gave to the Department of Energy.

Mr. BEDELL. Thank you very much.

Our next witnesses are Bradford Mead, Export Council for Renewable Energy, and Christopher Flavin of the Worldwatch Institute.

Mr. Mead, do you want to be first?

PANEL CONSISTING OF BRADFORD MEAD; AND CHRISTOPHER FLAVIN

TESTIMONY OF BRADFORD MEAD, CHAIRMAN, EXPORT COUNCIL FOR RENEWABLE ENERGY

Mr. MEAD. Certainly.

Mr. Chairman, I am chairman of the Export Council for Renewable Energy whose members include the leading renewable energy industries and associations. I am also director of international programs for the Grumman Corp.

Mr. Chairman, the United States has developed over the last 5 years the single largest photovoltaics industry in the world. The makeup of this industry is primarily small companies with great aspirations. Through the method of joint industry and Government involvement, we have produced some of the finest technology and innovative marketing programs of any industry in this country. More importantly, however, we have applied this expertise to overseas markets, and are currently shipping well over 50 percent of our production to foreign lands.

This is a most impressive record for an industry less than 10 years old. We have, however, in the process of building up our industry, demonstrated to the rest of the world that photovoltaics is in fact a viable business, and foreign governments are pouring in hundreds of millions of dollars to take their share of the markets.

If it were just a private sector competition between foreign competitors we wouldn't be here today. The reality is that foreign governments work hand-in-hand with their companies, promoting them, sending them to the United States to acquire our technologies and other markets as part of trade delegations, subsidizing the production of their manufacturing, granting low interest financing, and in many cases owning or part-owning the companies themselves.

In fact recently an American PV manufacturer was only able to get a prefeasibility study funded in a timely fashion for Jamaica by asking a Canadian firm to take the prime contractor role so as to be able to use Canadian prefeasibility funding. Obviously by using this route we have reinforced the Canadian position in Jamaica. They didn't have another alternative.

The rationale for these countries doing this is always the same: Jobs, foreign exchange and market positioning for the long-term, areas of interest to the United States too, I think.

The recent unsuccessful GAPP negotiation does not bode well to the idea that this situation is going to move toward the freer market; quite the contrary. The rise of protectionism and further Government support to our foreign competitors is most likely, and our government must now decide whether we as the U.S. industry will be left to compete on our own, or whether the investment and the success of our industry will be continued through carefully orchestrated joint U.S. industry-government programs.

In 1981, Mr. Chairman, such a program was enacted by the Department of Energy under the auspices of the Department of Commerce called the International Market Development Program. For an expenditure of about half a million dollars over one-fifth of the companies representing both PV and other solar technologies were taken and introduced to foreign markets on a cost-shared basis in the course of 9 months.

Projected sales from those trips over a 1-year period were estimated by the GAO to be well over $100 million. Most of the companies that went on those trips employed less than 50 people. That program was canceled in 1982 for lack of funding. However, recently a reduced version of that program has been authorized and the first event, the Far Eastern Mission, has just returned and was most successful.

Additionally, in September AID sponsored a cost-shared trade show in Zimbabwe and by all accounts it was extraordinarily successful. However, I am told that despite AID and Zimbabwe's vocal support of these types of joint industry-government shows, AID in Washington has decided that no further types of these shows will be funded. We would certainly be interested in knowing the rationale for such a decision. As you can see, there is much precedent for government-industry cooperation, but unfortunately this is decreasing at a time when our foreign competition is gearing up with their governments to establish themselves strongly in the marketplace.

The Department of Commerce has been most helpful and supportive of our industry, but they, too, can only operate within the guidelines that they are given. We the industry have noticed many U.S. Government resources being spent in the name of the photovoltaic industry, but many times this funding is being channeled into never-ending studies, not pertinent demonstration programs in isolated countries which have very little market potential.

Regarding program administration costs, there is clearly a need for better coordination of these resources. Certainly the counsel stands ready to assist in any way possible. Make no mistake, Mr. Chairman, there is an enormous market for photovoltaic products, and all indications are that a majority of this market will be outside of the United States.

We are well-positioned with our technology, but our success has attracted foreign competition, and they will compete with the complete support of their respective governments. If we are to have a place in the future international marketplace, we must make a similar commitment.

Thank you, Mr. Chairman.

[Mr. Mead's prepared statement follows:]

PREPARED STATEMENT OF BRADFORD MEAD, CHAIRMAN, EXPORT COUNCIL FOR RENEWABLE ENERGY

I am Brad Mead, Chairman of the newly-formed Export Council for Renewable Energy. Appended to this testimony is the Export Council's mission statement and list of member organizations. I also chair the International Trade Committee of the Solar Energy Industries Association. SEIA's membership includes over 325 companies involved in the research, demonstration, manufacture, distribution and sale of solar energy products in the United States and overseas.

In addition, I am Director of International Energy Programs for Grumman International, Inc., a wholly-owned subsidiary of Grumman Corporation. We are one of the largest domestic manufacturers of solar hot water systems, and we are actively engaged in efforts to sell our products overseas.

On behalf of the national organizations who have formed the Export Council for Renewable Energy, I would like to express our strong appreciation for the attention your Subcommittee is placing on the need for international commercialization of U.S. renewable energy technologies. The Small Business Subcommittee on Energy has long been in the forefront of supporting U.S. technological development for alternative energy sources. We are pleased with the concomitant concern for seeing to it that the technological developments are put to use.

Right now, and for the foreseeable future, the success of much of the American renewable energy industry depends upon its ability to sell in the world market. For many companies, increased production capacity that will lead to lower unit costs depends on growth in overseas sales. And the support of U.S. companies in their international sales depends, in turn, partly on the willingness of the U.S. Government to extend a helping hand to overcome some of the handicaps we face in relation to our foreign competitors. Those handicaps include:

Concerted marketing support by foreign governments for their renewable energy companies;

Established market prominence by some exporting countries in their former colonies;

A general lack of experience in the U.S. on how to conduct and support export trade, compared to other countries which have long had to place a high reliance on export sales and have developed sophisticated infrastructures to facilitate their exports.

The U.S. renewable energy companies are not looking for bailouts through export programs. Rather, we are looking for minimal effort from the government to help place some balance in a cutthroat and non-free international market environment. It is a market that may well be crucial to the survival of the U.S. renewable energy industry, and thus crucial to the protecting the investment this country has made in past years through the dollars it has spent for research and development in renewable energy production.

An immediate step we strongly support is a $1 million appropriation in fiscal year 1983 to continue a program for renewable energy overseas trade development along the lines of the highly successful program conducted jointly in 1981 by the Department of Energy and the Department of Commerce. This modest expenditure out of the renewables budget can have extremely large, short term payoff.

The 1981 program is estimated to have generated sales for U.S. companies in excess of 100 times the government outlay.

We are encouraged by the recent enactment of export trading company legislation, which makes an important new tool available to exporters. At the same time, we feel close examination needs to be made of existing government tools, such as the Export-Import Bank, OPIC, AID, and the Trade and Development Program, in order to determine how they might better provide support for renewable energy exports. In order to pull these tools together there needs to be a clear focal point in the government responsible for renewable energy exports.

Before discussing our recommendations, however, I would like to describe some of the problems we are encountering in our overseas marketing and which brings about the need for export support programs.

Marketing support programs of other governments

Today you have been presented with documentation of the plummeting scale of U.S. research and development spending for renewables relative to R&D programs of the countries with whom we compete. There is no need today to restate the quantitative aspects of the slashed budget for renewables in the U.S. Suffice it to say that as our R&D efforts are going way down, the efforts of other countries are either going up or, at least, are being trimmed more gradually than our efforts. As described by Mr. James Corr in summarizing findings of the analysis of country spending conducted by DHR, Inc., "if the U.S. solar budget is reduced in 1983 (as proposed) it will undoubtedly become one of the lowest as a percentage of total energy spending in the developed economies, and will in fact fall below, even in absolute terms, the levels of several countries much smaller than the U.S.A."

I would, however, like to focus attention on the commercialization support that our foreign competitors receive from their governments. Part of that support comes from the government R&D programs. As you may be aware, foreign governments tend to place their primary research emphasis on near-term product development, both for their own oil displacement and for export sales.

The market support goes far beyond research and product development, however. Long term investment and marketing strategies are sometimes made jointly between industry and government; frequent trace missions composed of government officials and businessmen visit developing countries drumming up renewable energy business; demonstration projects using off-the-shelf equipment are donated to developing countries, leading to future sales for equipment from the same company; training programs run by companies but financed by the government are provided to developing countries, again leading to future sales of familiar systems; aid programs are tied to broad purchasing arrangements for equipment from the donor countries; and most importantly, liberal financing is made available through export financing subsidies and through mixed financing packages (export credits and concessional aid).

In short, the principal nations with whom we compete—France, Germany, Japan, and increasingly, Canada—have made a consicious policy decision to pursue aggressively the export market for renewable energy. They see renewables as an important growth market in the Third World, and as an important industry to have strongly established for their own domestic energy needs. By doing whatever is necessary to establish an early market presence in the Third World for their own companies, the governments of foreign competitors are attempting to assure that their companies will be in the right place as the growth in renewables takes off.

It should come as no surprise that we face this type of competition in the international renewables market. Other countries regularly employ industrial policies in which key sectors are strongly supported in domestic and international markets. Those industrial policies can have effects far beyond the country which initiates the policies. This is particularly true in hard economic times when it is attractive to export unemployment. Witness; for example, this summer's finding of massive dumping by foreign steel producers in which exports to the United States were found to have been subsidized at rates up to 40 percent.

The support policies that other countries provide their renewable energy companies manifest directly as projects lost to U.S. firms. Anyone dealing in this international market knows that frequently the first question asked in a developing country is "What kind of external financing can you provide?" Having no competitive financing package to offer, the U.S. firms are often off to a very weak start. One major U.S. photovoltaic firm has noted that "we write the specifications for projects, and then other companies with country financing make the deals."

It may be useful to list some of the specific cases I have witnessed:

In Greece, the Germans donated five llKW wind machines, manufactured by the German company M.A.N., as a demonstration project. The same procedure—free, large-scale wind machines donated as a demonstration project—was used by the Germans in Malta.

The Japnaese company Yazaki has been very successful in promoting their flat plate solar collectors through unbeatable financing packages. They have been active in a number of countries, including the Philippines, Australia, Chile and Spain.

In Egypt, the Canadian government backed the Canadian company Petro Sun in winning a contract for 2,000 solar water heaters. Ironically, the specifications for the project were written with technical assistance from the U.S. government. The specifications. however, contained so many stringent provisions (e.g., advance deposit of all project costs in an Egyptian bank) that no company without substantial government backing (and thus no U.S. company) could have met the requirements.

Representatives from other U.S. companies have told similar stories. For example:

In Bahrain, an American company initiated the idea for a major photovoltaic project last year, but lost out when the French stepped in and donated a PV system for the entire U.S.-conceived project.

In China, a group of U.S. solar company officials were invited on a trade mission in 1979. The group traveled at their own expense only to find that the Chinese expected assistance programs, not commercial projects. Simultaneously a delegation of German company representatives arrived in China, announcing a $DM 3 million solar "starter" program consisting of a series of demonstration projects. The Germans were thus off to a good start in building Chinese market potential while the U.S. companies were left in the cold.

In Iraq, Jordan, and Kuwait the Germans have given money to research institutes with the intention that the German firm AEG Telefunken would get project contracts. The Japanese have used the same approach in Qatar and the U.A.E.

In Dominica a French firm won a geothermal bid after the French government financed the project's feasibility study.

Through government agreement, the huge IEA project in Almaria, Spain was carried out in part by American firms and in part by German firms. The juxtaposition of the two governments provided a study in contrast of approach. The U.S. government maintained its traditional arms-length posture in relation to the American contractors. At the same time, the German firm worked in close cooperation with its government and received support in getting as much of the business as it could.

By citing these examples and describing the nature of the competition we are facing, I do not mean to imply that U.S. companies are frozen out of the international market already. Far from it. Export markets are a very important component in the American solar industry's sales portfolio, and the U.S. is still the largest exporter of renewable products in the world market. In 1980 American renewable energy exports totaled $36 million. The leading export segment was photovoltaics with 69 percent of total sales ($25 million) followed by solar heating and cooling 7 percent ($7.4 million), wind 3 percent ($1.0 million), solar thermal electric 3 percent ($1.0 million), and support products and services 4 percent. Yet these figures represent only a tiny fraction of the international sales potential that is beginning to take shape.

The instances I have cited indicate clear trends pointing to serious problems ahead. The increasingly stiff, government-backed competition is laying the groundwork for carving out large market niches that U.S. companies will not be able to penetrate. Smaller U.S. companies especially will be left behind, unable to devote resources to the complexity of fighting the international competition.

It is in this light that we feel government support for renewable energy export is essential in order to counter the close support our competitors receive for their governments.

Recommended actions

The Export Council for Renewable Energy recommends the appropriation of $1 million in 1983, to support efforts in several areas which will assist the U.S. renewable energy sector in meeting international competition:

1. *Continuation of the Program for Overseas Trade Shows.* The International Market Development Program was sponsored by the Departments of Energy and Commerce in 1981, and has since died. It was one government program that attempted to alleviate some of the competitive disadvantages facing our industry in the international market.

During fiscal year 1981, the international market development program conducted a series of overseas trade shows and seminars which according to the recently released GAO report produced immediate sales of about $3 million and from which participants projected 12 month future sales of about $60 million.

The total cost incurred by the Department of Energy in sponsoring this program was $500,000. The return on investment clearly indicates the cost effectiveness of such trade promotion events. When one takes into consideration that the total level of U.S. renewable exports in 1980 was $36 million, the dollar volume potentially generated by this first trade promotion had the effect of almost doubling American export sales. The fiscal year 1982 budget eliminated this very successful program.

The concept of cost sharing in the sponsorship of a joint industry/government trade show had the most significant effect on middle and smaller size businesses who for the first time were able to participate in the international market.

With the support of Congress the Department of Energy has allocated $200,000 of its 1982 funding to support the participation by renewable energy companies in the International Trade Administration's (Department of Commerce) Trade Development Program. The ITAS program, similar in many ways to the 1981 program I just referred to, is operated on a full cost recovery basis. Most renewable energy companies cannot afford the cost of participating, thus the DOE money, used to cost share on roughly a 50–50 basis, is essential to their participation.

A recent trade mission visiting three cities in the Far East organized for renewable energy companies by ITA, and which used DOE funds for cost sharing, was a spectacular success. At one stop alone, estimated direct sales were generated at a level in excess of 100 times the federal cost for the entire mission. Such leveraging of tax dollars can obviously benefit both the nation's balance of trade and the U.S. renewable energy industry in its important early years of growth.

These types of programs have proven to be surprisingly successful as door-openers for U.S. exporters. They offer means for U.S. sellers to meet key government officials and potential buyers, as well as potential joint venture and license partners. In addition, the participants receive a valuable incountry feel for the market.

Let me offer one more example of the types of successes that can come from overseas shows. The United States provided a pavillion at the exhibition at the U.N. Conference on Renewable Energy in Nairobi last August. One company at the U.S. pavillion displayed its photovoltaic medical refrigerator. The company reports that more than 20 percent of its sales in this product line this year are directly attributable to its exposure in Nairobi.

2. *Technical and Program Support of Public and Private Export Development Efforts.* Awareness of emerging renewable energy technologies is deficient, among both U.S. overseas commercial officers and private export companies. The recently enacted Exporting Trading Company Act could prove to be very useful for small and medium sized U.S. renewable energy companies that are not equipped to enter the

international market on their own. The trading companies that may emerge, however, must first become interested in promoting renewable energy products.

3. *Review and Coordination of Program That Can Support Renewable Energy Export.* A host of government programs exist which either do or could play a significant role in renewable energy exports. Each of them is designed to address different types of circumstances—some address economic development needs of Third World countries, while others focus on U.S. commercial interests; some focus on direct sale exports from the U.S. while others deal with overseas investments. Taken together, if all these programs were activated and coordinated to help support renewable energy trade, the United States would have a powerful, flexible program to counter disadvantages that the U.S. companies now face in international trade.

To properly activate and coordinate these programs on behalf of renewable energy would require at least three initial stages: First, a conscious policy decision by the government (similar to the determinations made by the governments of our competitors) that renewable energy is of particular long range importance to developing countries and to our domestic interests, and therefore, deserves attention from each of the relevant programs. Second, a review of the structure and criteria of each of the programs to assure that they can provide what is needed for renewable energy exports. Third, establishment of a clear focal point in the government for renewable exports which can keep some pressure on the separate programs so that, despite the varying missions of the programs, a concerted and coordinated approach is followed for supporting renewable exports.

We fully realize that this comprehensive approach is not a goal likely to be achieved very quickly. It is important, though, to begin the process of reexamining the major programs that could offer more focused support for renewable energy exports. These major programs include the following:

Export-Import Bank: Exim could hold the key to the ability for U.S. companies to offer competitive financing packages to foreign buyers. We strongly urge that careful review of the Bank programs be made in order to determine how export credits could be supplied for renewable energy export projects, and how the full range of Exim services could be made more accessible to renewable energy exporters.

Trade and Development Program: TDP serves the dual purpose of supporting U.S. exports to developing countries and supporting projects that are important for economic development in the developing country. It serves these purposes primarily through funding of feasibility studies for projects in LDC's. Renewable energy projects seem to fit naturally into IDP's dual mandate. However, the agency has funded very few renewables projects and has no plants for doing more in this area.

A major cause of TDP's inattention to renewables is probably its incredibily low funding level. The current program funding level for TDP is $5 million This is contrasted with comparable programs in the European Community which are funded at estimated $40-60 million. The comparable Japanese program is estimated to be funded at a level in excess of $100 million.

Because of the agency's very limited funding, TDP policies call for support only of programs with an extremely high, short-term pay back to the U.S. economy in terms of first tier exports. Criteria for project approval include the likelihood of 100-to-1 payback in 2-5 years. The presumption is that renewable energy projects are very unlikely to meet these requirements.

The feasibility-study funding services of the Trade and Development Program could be particularly helpful to U.S. firms in meeting the government supported competition we are facing in developing country markets. Examination of TDP's project criteria ought to be made to see if more flexibility could be possible in order to allow funding of renewable energy projects. In addition, significantly higher funding should be made available to TDP.

OPIC: The Overseas Private Investment Corporation is designed to facilitate developmentally sound U.S. investments in developing countries, primarily through political risk insurance, but also through direct lending and other services. Despite its mandate to place special priority on energy sector projects, OPIC has given little attention to support of renewable energy investment projects. As with the Trade and Development Program, OPIC could play an important role in facilitating the presence of U.S. renewable energy companies in developing country markets, particularly as those countries increasingly seek local-value-added investments rather than direct sales from developed nations.

AID: In the past several years the Agency for International Development increased considerably its attention to renewable energy. However, a common reaction among industry representatives is that too often AID has focused on spurring cutting edge technology that is not commercially replicable, rather than facilitating the flow of currently available technologies or facilitating adoption of current technologies to broad Third World needs. Careful attention should be given to see whether there might be ways to better incorporate renewable energy commercial interests with the development objectives of the Agency.

International Trade Administration: The Department of Commerce's ITA should establish renewable energy as a high priority sector for export support. By giving renewables higher visibility within the International Trade Administration, a natural result will be higher attention paid to this sector by the commercial attaches at the U.S. embassies. The range of foreign commercial services available can be quite helpful, in addition to supporting trade missions, particularly when priority attention is evident at the policy level.

One indication of other useful roles that can be played by the commercial attaches occurred at the recent solar exhibition in Houston, held in conjunction with the American Solar Energy Society Conference. The commercial attaches were asked to stimulate interest among foreign buyers, and as a result more than 200 foreign buyers did travel to Houston.

Continued in-country work by the Commerce Department network, coupled with overseas trade shows and overseas missions of business and government officials will reap large and immediate rewards in terms of U.S. renewable energy sales. It is precisely this type of commitment that is making our foreign competition as successful as it is.

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Mr. Chairman, I have attached to my testimony a copy of the Export Council for Renewable Energy's fiscal year 1983 program proposal, encompassing the range of proposed activities described above.

The Administration has consistently stated that the private sector should provide the solution to Third World energy needs. The renewable energy industry is ready and eager to provide a growing part of that solution for developing countries. But we will never be able to fulfill our role by ignoring the realities of the real world.

As it stands now, the real world of international marketing for renewable energy is one in which the U.S. will increasingly lose ground because it is not playing under the same rules as our competitors. We may not like those rules, but until they are changed—and that will not happen quickly—we must be prepared to put some of our own export support tools to better use on behalf of renewable energy. Failure to do so will preclude us from many long term international markets, and as a result will also impede our ability to grow sufficiently to meet the future needs of the domestic market.

Once again, Mr. Chairman, we deeply appreciate your willingness to bring these important issues to light.

Mr. BEDELL. Thank you very much. Mr. Flavin.

TESTIMONY OF CHRISTOPHER FLAVIN, SENIOR RESEARCHER, WORLDWATCH INSTITUTE

Mr. FLAVIN. Thank you, Mr. Chairman.

I am a senior researcher at the Worldwatch Institute, which is a private nonprofit research organization based here in Washington. I have been conducting research on renewable sources of energy for the last 3 years and recently completed a paper entitled, "Electricity from Sunlight: the Future of Photovoltaics," that looks at worldwide trends in the PV industry.

The key thing to recognize in looking at photovoltaics markets today is that they are evolving very rapidly and that there is a lot of volatility associated with that evolution. They have been growing at approximately a 50-percent annual rate since the midseventies, and continue to do so.

The world market has grown from a few hundred kilowatts of capacity in the midseventies to approximately 8,000 kilowatts today. This rapid growth is virtually certain to continue, making photovoltaics a $1 billion a year industry by the late 1980's, and close to the $10 billion mark by the year 2000.

With such rapid growth the stakes are obviously high and the opportunity for new competitors to gain ground rapidly is large. International competition has been heating up dramatically in the last few years, as other witnesses have indicated.

Of 60 solar module manufacturers in the world today, approximately 25 are in the United States, 15 in Japan, 12 in Europe, and 8 to 12 in a number of developing countries. Perhaps half the foreign firms have been in business only since the late seventies. The rise in the number of foreign firms appears to be continuing and I think we will see further growth overseas in the next few years.

Exactly what the international market shares is difficult to know for sure. A number of industry analysts make estimates, but no thorough polling is done. My assessment after interviewing a number of people who are close to the industry is that the U.S. share of the market has already fallen fairly substantial from 80 percent a couple of years ago, to something on the order of 55 percent today, during a period in which the U.S. Government drastically cut back its programs, and a number of other countries stepped up theirs.

Some of the countries that are moving most quickly in addition to Japan are France, Italy, and West Germany. The shift that has occurred so far has come without a major marketing push on the part of governments in those countries. I think we could easily see a much more dramatic shift in the near future.

One area that we are most concerned with at Worldwatch is the energy problems of developing countries. In this regard, we see a very large potential to use photovoltaics in villages and rural areas of developing countries almost immediately. There are literally hundreds of millions of people in developing countries who do not now have electricity and will not have it within the foreseeable future unless small decentralized systems are available to provide it.

In many instances, photovoltaics already appears to be the most economical way for these countries to go. Sunlight is plentiful in most parts of the Third World, and diesel generators, though important today, are generally thought to have a great many drawbacks. They are expensive and tend to be unreliable and break down frequently. Just a few kilowatts of power in a Third World village can provide enough energy for 100 families, though a few kilowatts often are only enough to provide for a single family's needs in the United States.

So the opportunity to use photovoltaics, even at a time when it is still relatively expensive compared to our conventional sources of electricity, is large. The market for photovoltaics in developing countries has clearly begun to stir in the last several years. Just to name a few countries that appear to have a commercial market growing up very quickly: Brazil, India, Pakistan, the Philippines, and Thailand.

Given the likely price trends that most of us see in the next few years, this market is going to grow rapidly. It is important to recognize, from the industry point of view, that industries of other countries are going to have important advantages in tapping these growing markets. Traditionally the industries of these countries have put much more reliance on international markets. Many have established markets for pumps, generators, batteries, and other technologies with which photovoltaics will naturally be linked.

This experience and expertise in international markets is a real countervailing force to the U.S. technological lead. I think that it is almost certainly true that international markets are going to continue to be very, very important for photovoltaics for the foreseeable future.

Though the United States does have a substantial opportunity to use photovoltaics domestically in the next decade, it is clearly dwarfed by markets in other areas of the world where electricity is much more expensive. We can be confident saying that companies which do not establish their technology in international markets early will find themselves at a distinct disadvantage in the rapidly evolving PV industry.

Let me turn briefly to the role of governments in photovoltaics. A number of other people have covered it quite well. The trend in the last 2 years is very clear. Government programs in the United States have gone from $160 million in 1980 to about $50 million in 1983, depending on exactly what the appropriation turns out to be. Most of our competitors are raising their budgets. In Japan, the budget for photovoltaics has risen 140 percent to approximately $30 million this year, and including indirect government support is about on a par with the U.S. program.

Looking back, the U.S. Government PV program was larger than all others combined just a few years ago. There is irony in the fact that a conservative free market Government in the United States is ignoring the signals of the marketplace, boosting support for the fading nuclear industry while cutting off funds for rapidly growing solar cell companies.

There are three areas of most concern to me in looking at the problems of the U.S. Government programs today: One, we are doing away with commercialization programs almost entirely, with the idea that somehow that is not a proper role for government, an assumption that completely ignores the history of government involvement in energy technology in general and, specifically, the real needs of the U.S. PV industry today.

Private companies clearly have the major responsibility for commercialization, but they are desperately in need of funding to get current technologies across the financial chasm and into the rather expensive large-scale plants that are needed to make photovoltaics economical.

If we compare the Japanese program with the U.S. program, it is clear that in Japan there is none of this notion that government should just be involved in basic technology. All the Japanese programs—which incidentally were originally modeled after U.S. programs—are designed to take technologies through the pilot plant stage, an approach that generally is followed in Europe as well.

Redressing this imbalance between high tech R&D and commercialization is as important as the sheer quantity of money that is budgeted for photovoltaics.

A second area that I am concerned about is export assistance for the U.S. industry, particularly the smaller firms which do not have the money to have a large marketing staff traveling all over the world the way the large Japanese electronics firms are able to do.

Clearly we should have an office in either the Department of Energy or the Department of Commerce which is devoted to accumulating information and getting it out to the companies who need it.

This sort of information has to be based on real experience in the developing countries, that is relying on people, perhaps based in embassies, who gather information, who know what the market is for pumps, for household electricity, for the variety of things that photovoltaics can be used for.

Third, there is a desperate need to take a longer-term approach to photovoltaics and to other renewable energy sources as well. U.S. R&D programs, commercialization effects, and tax incentives have tended to swing widely from year to year, an approach that is very different from that in Japan, which operates a steady multi-year program so that the industry there knows how much money will be available, not just next year but 2 or 3 years after that.

Such programs can be flexible. They don't have to be locked into a set of technologies, but the basic level of commitment does need to be set.

Government in the United States by pulling back so dramatically in the last few years, has been responsible for giving a false impression to the U.S. public that the solar energy star has faded when in fact in photovoltaics that progress is continuing rapidly.

Let me conclude by noting that the beauty of Government support of photovoltaics in general is that it can be an inexpensive, cost effective way of supporting the industry. The strength of U.S. photovoltaics technology is recognized around the world and if the price is right and the necessary links are established, many people prefer to buy American. In the longer term, establishing such markets will help the United States maintain its leadership in one of the biggest growth industries of the late 20th century, and develop a major source of energy as well.

Photovoltaics is also an industry in which the United States can support Third World industrialization by joint ventures that bring benefits to both sides. In economic, strategic, and humanitarian terms, the international photovoltaics industry has the potential to provide immense benefits to the United States if we take some small steps today.

Thank you.

[Mr. Flavin's prepared statement follows:]

PREPARED STATEMENT OF CHRISTOPHER FLAVIN, SENIOR RESEARCHER, WORLDWATCH INSTITUTE

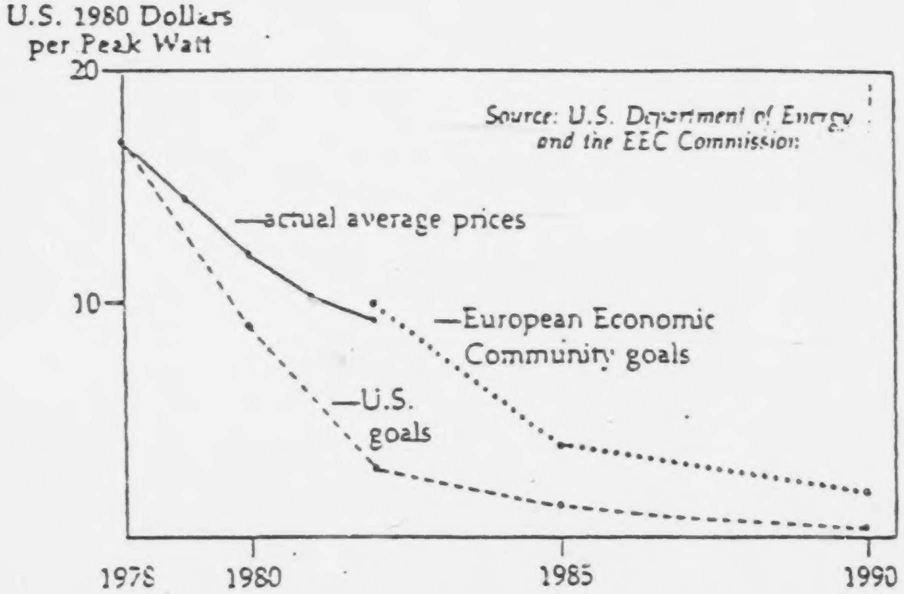
I appreciate the chance to appear before the House Small Business Committee's Energy Subcommittee as it examines the current state of the photovoltaics industry. I am a Senior Researcher at the Worldwatch Institute and have been conducting research on renewable sources of energy for the last three years. Most recently I have completed work on a soon to be published Worldwatch Paper, Electricity from Sunlight: The Future of Photovoltaics. As preparation for that study I have reviewed the photovoltaics literature and have conducted interviews with industry officials and analysts. My remarks today will be drawn from that study.

The photovoltaics industry has evolved rapidly in the last several years. Research progress in hundreds of industrial and university laboratories in the United States and abroad has been substantial. Solar cell production has simultaneously become much more competitive internationally. Today approximately 60 companies are manufacturing photovoltaics in 20 different countries, twice as many firms as were active five years ago.

A healthy market for photovoltaics has emerged, mainly for small scale applications in remote areas where power lines do not exist. Communications, water pumping, and household uses are among the most popular applications for solar electricity. Much of the market is in rural areas of the developing world. Growth of photovoltaics markets would be even more rapid were it not for the current global recession, but progress continues nonetheless. Photovoltaics is a welcome contrast: a healthy "sunrise" industry in a sea of economic and energy troubles.

Cost reduction is the key to solar electricity's current role and future. Photovoltaics has so far followed a remarkable cost curve. Average solar module prices have plummeted from $20 per peak watt in 1977 to less than $10 in 1982. (See Figure 1.) In few other industries have costs fallen so rapidly. Yet even at today's prices, a photovoltaics system just large enough to power a 100-watt light bulb would cost at least $1,500, so further cost reduction is obviously essential.

Both government and private research programs have set specific cost goals for each of the various components of a system, from silicon refining to final installation. These programs regularly monitor progress in the various areas and occasionally redirect research efforts to more promising materials or designs. Under the Carter Administration the U.S. Department of Energy (DOE) aimed to develop the technology needed to bring market prices for photovoltaics moduled down to $2.80 per peak watt (in 1980) dollars by 1983, to 70¢ per watt by 1987 and 40¢ per watt by 1990. (See Figure 1.) More modest but still optimistic goals have been established recently by the European Economic Commission and the Japanese government. Each calls for a 1985 figure of about $5 per peak watt (1980 dollars) and $2 per watt by 1990.



Source: U.S. Department of Energy and the EEC Commission

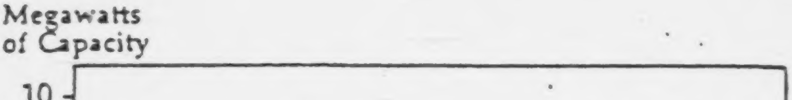
Figure 1: Market Prices and Price Goals for Photovoltaic Modules, 1976-1990

It has become clear in the last few years that the Department of Energy's price goals (which are being ignored by the Reagan Administration) will not be achieved on schedule. Although technologies have been developed at about the pace expected, large-scale production and marketing of these new technologies is expensive and cannot occur overnight. As originally conceived the goals were ambitious considering the modest funding allocated to achieving them. The combination of economic recession and major cutbacks in the Department of Energy's commercialization programs has made the goals quite unrealistic.

The fact that progress is occurring a little more gradually than some had hoped should not diminish the importance of the advances already made and projected to continue in the coming years. Important advances are occurring in Czochralski silicon cells, ribbon cells, polycrystalline cells and thin-film technologies. All four "generations" of photovoltaics technology are now on the market, and manufacturers are scaling-up production processes to an unprecedented extent. Competition among the various manufacturers is likely to be intense and will tend to push prices down.

Since the early seventies the photovoltaics market has been growing at over a 50 percent annual rate. The yearly manufacture of solar cells has grown from a few hundred kilowatts of peak power capacity in the mid-seventies to about 8,000 kilowatts (8 megawatts) in 1982. (See Figure 2.) Such rapid growth is likely to continue for the rest of this decade. Worldwide annual production of photovoltaics is likely to rise to between 200 and 300 megawatts of capacity by 1990 and to over 1,000 megawatts by the end of the century. This will make the photovoltaics business a billion dollar industry by the late eighties and push it close to the $10 billion mark by the year 2000.

The photovoltaics market will likely evolve gradually rather than in discrete stages and at each point there should be a range of technologies to choose from—each with its specialized applications. Module prices will probably fall to approximately $3 per watt (1980 dollars) by 1987 and to about $2 per watt in 1990. At that price a total solar electric system will cost between $4 and $8 per watt and generate electricity at a cost of 15¢ to 30¢ per kilowatt-hour (as opposed to over $1 per kilowatt-hour today). This is getting close to standard electricity prices in many parts of the developing world as well as Europe and Japan. Predictions beyond the early nineties are difficult to make since they are dependent on technologies barely beyond the laboratory stage. But further substantial cost reductions are likely since the photovoltaics market will be large enough to attract big investments. Given the rising costs of most sources of electricity, including coal and nuclear power, photovoltaics is likely to be a competitive electricity source in all but a few areas of the world by the mid-nineties.



Source: Strategies Unlimited

Figure 2: Annual World Production of Photovoltaic Cells, 1970-1982

Perhaps the most important shift in the photovoltaics industry in recent years is the proliferation of companies outside the United States. Of the approximately 60 established solar module manufacturers, the United States has 25, Japan has 15, and Europe has 12. Another 8 to 12 companies are producing photovoltaics in developing countries, all on a small scale. Half of these companies have been in business only since the late seventies and it is likely that another 20 to 30 companies will enter the business in the next few years.

Already U.S. companies' share of the world market has fallen from approximately 80 percent in 1980 to 55 percent in 1982. This is a surprisingly rapid turnaround, particularly considering that U.S. companies continue to hold a clear technological lead in most areas and companies abroad have only begun to step up their commercialization and marketing programs.

Today the Europeans and Japanese are moving rapidly to shed their underdog image. Firms in these countries have made significant progress in recent years, swiftly closing the gap in some fields. French photovoltaics expertise has been consolidated under two major companies—Photowatt and France-Photon. The first has oil company and government funding and the second is a subsidiary of a U.S. firm. Similarly, West Germany has two large electronics companies dominating the solar cell business. Italy too has made a major commitment, with its government directly owning most of the country's growing photovoltaics industry. In Japan, large integrated electronics firms such as Fuji, Sanyo and Sharp have staked out a strong position. By studying American technology and carefully plotting their own course, Japanese companies have leapfrogged close to the "cutting edge" in amorphous silicon production and other areas, creating a stir in the photovoltaics industry around the world.

Companies abroad have been helped by the fact that photovoltaics is developing in a climate of global information exchange and international business relationships that would have been inconceivable a decade or two ago. Extensive travel and communication among scientists rapidly spread new technologies around the world, and production processes are flexible enough that patents cannot easily protect particular technologies. In the last few years, international joint ventures and licensing arrangements have become popular in photovoltaics, allowing companies to enter foreign markets and boost sales. Solarex, an American firm that is one of the two largest in the world, has already established nine joint ventures, most of them in Europe. Japanese researchers now regularly attend major photovoltaics meetings in the United States, bringing home important new information. Budget cutbacks have made it difficult for U.S. researchers to make similar trips to Japan.

The export market for photovoltaics will be particularly critical in the mid- to late-eighties when solar electricity will not yet be economically competitive with conventional power sources in industrial regions. The largest market during that period is almost certain to be in developing countries where centralized electric grids are not yet widespread and photovoltaics is rapidly becoming an economical source of power.

In many Asian countries including India, Pakistan, the Philippines, and Thailand there is a growing market for photovoltaics to power communications systems, water pumps, agricultural equipment and the like. Experimental solar systems have been used to provide electricity for Third World villages, and this may be a widespread approach to rural electrification by the late eighties. In developing countries just a few hundred watts of power can have an immense impact, removing some of the drudgery from village life and helping to boost productivity.

Marketing skills will be as important as technical expertise in tapping these export markets, an area where European and Japanese companies already have a head start. Firms in these nations have traditionally made over half of their sales abroad, and their executives have long courted Third World buyers. Indeed, some European and Japanese firms already market in Third World countries many of the technologies compatible with photovoltaics, such as pumps, generators and batteries. Establishing these channels takes years and is almost as difficult as developing a new technology.

Integrating solar electric systems into such existing markets already has given French firms an advantage in West Africa, West Germany firms an edge in Latin America, and Japanese firms an advantage in Southeast Asia. Some American companies have begun selling their products abroad via local sales representatives, and one company claims that its staff members speak a dozen languages, ranging from Urdu to Greek. But many U.S. photovoltaic systems are marketed via Europeans intermediaries—not a good omen for the American industry.

The development of the solar calculator is a good example of the innovation and marketing skills that Japanese companies have brought ot the photovoltaics industry. Using a tiny photovoltaic array that generates only a few thousandths of a watt, solar calculators have no battery and no on-off switch. When light strikes the solar cells the calculator automatically turns on. Because power requirements are so small, the solar array hardly adds to cost, and the calculators are sold competitively at $10 to $30. Without wires or batteries, solar calculators operate effectively with the light available in most rooms. And because both the calculator and its power system are solid-state devices, they should last indefinitely. The Japanese have developed a remarkably strong market that in just a few years has grown to between 10 and 20 million calculators annually. Moreover, many of these calculators now employ amorphous silicon, making this the first commercial use for an important new photovoltaic material. U.S. companies that did pioneering work in both amorphous silicon and hand-held calculators have had no part in the early development of the solar calculator market.

The international spread of the photovoltaics industry is to some extent a natural development. There is no particular reason that one country should dominate an industry such as this one, involving materials that are widely available and dispersed markets spread throughout the industrial and developing worlds. Photovoltaic modules are bulky and breakable which will tend to encourage local production. Moreover, many countries see photovoltaics as a strategic industry and do not want to trade oil dependence for dependence on photovoltaics manufacturers located thousands of miles away.

There is nonetheless cause for concern, particularly considering the speed with which the U.S. industry appears to be losing market share. Since there are important economies of scale in producing solar cells, export markets are likely to be crucial in turning out a competitive product in the coming years. Companies in industrial nations that establish joint ventures and licensing arrangements in developing countries can quickly establish a strong export market for cells while the developing country boost its economy by assembling photovoltaic modules and systems and by installing them—the most labor-intensive part of the photovoltaics industry. Companies that do not establish their technology in international markets early and develop relationships with the industries and governments of developing countries will find themselves squeezed out of the rapidly evolving photovoltaics industry.

One factor in determining the strength of U.S. companies in the international photovoltaics market is the policies of the U.S. Government. The United States has traditionally had the largest government program in photovoltaics, but the tide has turned, with the Reagan administration slashing the photovoltaics budget from $150 million in 1980 to about $50 million in 1983. Meanwhile, Europe and Japan are moving in the opposite direction. Solar cell budgets have increased in several European countries, particularly in France and Italy. The European Economic Community has also stepped up its support, which includes a series of demonstration projects throughout Europe. Together these programs have an annual budget approaching $50 million. In Japan the photovoltaics budget has risien 140 percent in two years to over $30 million. Including indirect government support, it is only slightly smaller than that of the U.S. program.

Governments do a number of things with their photovoltaics funds. They help support R&D both in industry and university laboratories. They use loans and grants to assist private companies in developing low-cost manufacturing processes. And they create markets for solar cells by purchasing photovoltaic systems for government facilities or foreign aid projects. Effective support of the photovoltaics industry requires a balance between these different activities, a point that energy planners in Washington have recently ignored. The remaining U.S. Government funding is directed largely to basic R&D. Efforts to help commercialize low-cost technologies have been gutted. Industry representatives, noting the large investments required to bridge the gap between the laboratory and marketplace, say the value of the remaining R&D programs will be minimized if the government ignores commercialization.

Ironically, a conservative free-market government is ignoring the signals of the marketplace, boosting support for the fading nuclear industry while cutting off funds for rapidly growing solar cell companies. The results will not be apocalyptic, but they will slow progress in the U.S. However, European and Japanese programs retain their balanced approach. Perhaps the most effective government photovoltaics program in the world today is in Japan. Originally modeled after the U.S. program, Japanese efforts today stress cooperation between industry and government. The government helps private companies take all technologies through the pilot plant stage, and long-term programs guarantee a continuing commitment regardless of year-to-year political changes.

The close relationship between European and Japanese firms and their governments is one reason that they are so strong in international markets. Development assistance programs sponsored by France and West Germany help build markets for these nations' corporations, and photovoltaics has been a major beneficiary. In Japan, the Ministry of International Trade and Industry (MITI) has a worldwide reputation for its success in helping domestic corporations develop export markets. Though photovoltaics has received only modest support from MITI to date, assistance is expected to increase rapidly as Japanese firms become active in the international photovoltaics market, which until recently they saw as too small to be worth a major push. In contrast, the U.S. Agency for International Development has funded several demonstration projects, but does little to find markets for American technologies. The U.S. Government's Commerce Department, Export-Import Bank, and various overseas embassies today provide only limited, unfocused assistance for U.S. photovoltaics exporters.

There is no easy way to predict future market shares in photovoltaics. However, those who do climb out on the forecasting limb are betting mainly on Japan. That country's recent success in marketing high-technology products around the world, combined with its growing national commitment to photovoltaics, make it a formidable competitor. In recent years Japanese officals have made it clear that they welcome the cuts in the U.S. photovoltaics program and hope to use this opportunity to close ground on the U.S. industry. Unless U.S. Government programs are stepped up soon, or private industry dramatically boosts its investments, Japan will probably surpass the U.S. in solar cell sales by the close of this decade. Considering the strong interest of Japanese companies in export markets, American homes might one day be powered by solar electric systems made in Japan.

The U.S. is now in the strange position of having to learn from other countries how to support effectively an industry in which the U.S. pioneered. There should be several priorities. One is to boost the photovoltaics program so that the resources committed to it are commensurate with the immense potential we now know it to have. One gauge to use is the breeder and fusion programs which are also devoted to developing new sources of electricity that would provide power mainly after the turn of the century. Together they receive over $1 billion each year though neither is likely to become a self-supporting industry or provide significant amounts of energy as soon as photovoltaics.

In surveying government programs in general, one of the most serious concerns of the photovoltaics industry is the short-term nature of these programs. Almost unique in the industrial world, U.S. support for photovoltaics and other renewable energy sources swings widely from year to year, and so businessmen must always assume the worst. In the last two years, the photovoltaics program has been cut by more than half and today, more than two months into fiscal year 1983, and we do not know how much money will be available. The result, needless to say, is chaos for program managers and industry participants. In contrast, photovoltaics programs in Europe and Japan are much steadier, based on multi-year planning that is flexible but lays out a basic commitment that industry can count on. The U.S. Congress should seriously consider adopting a similar approach as it already does in the defense and nuclear areas.

New funds devoted to photovoltaics should be used for commercialization as well as R&D. The current skewing of the U.S. program has no basis either in the history of government support for energy technologies, the needs of photovoltaics firms, or the long-term interests of the country. By greatly expanding current cost-sharing commercialization programs, government can help companies make the now-critical step of getting advanced technologies into the market ahead of the competition. Such programs should be coupled with tax incentives that help stimulate the market for photovoltaics with only minor government involvement.

Also essential are new and expanded programs to encourage the export of photovoltaic systems. U.S. companies wishing to export photovoltaics are currently at a distinct disadvantage vis-a-vis their European and Japanese competitors whose governments gather detailed market information, integrate photovoltaics into bilateral assistance programs, and subsidize exports with low-interest loans. It is particularly difficult for the smaller U.S. companies that cannot afford large marketing staffs to compete in such an environment. Often they must rely on a local sales representative who by himself has responsibility for a whole country or region. Perhaps the highest priority should be to restore the Commerce Department's program to assist the industry. Working through local embassies, U.S. officials can gather needed information on future markets and establish contacts with local businessmen and farm leaders. Trade fairs are a useful way to introduce local people to U.S. technologies.

> The beauty of such programs is that they can be an inexpensive, cost-effective way to supporting the industry. The strength of U.S. photovoltaics technology is recognized around the world and if the price is right and the necessary links are established, many people prefer to buy American. In the longer term, establishing such markets will help the United States maintain its leadership in one of the biggest growth industries of the late twentieth century and develop a major future source of energy. Photovoltaics is also an industry in which the U.S. can support Third World industrialization via joint ventures that bring benefits to both sides. In economic, strategic and humanitarian terms, the international photovoltaics industry has the potential to provide immense benefits for the United States if we take some small steps today.

Mr. **Bedell.** Thank you, Mr. Flavin.

Mr. Mead, you mentioned an investment of $500,000 that resulted in according to your figures $100 million in sales. I didn't get exactly what that was.

Mr. **Mead.** Mr. Chairman, in 1981 we had an international market development program which was most successful. The expenditure on actual assistance to American companies going overseas was about one-half million dollars. These companies subsequently by being overseas on a cost-shared basis at various trade shows and things that the Department of Commerce helped to set up, were able to sell in the order of about $100 million in exports over the period of 12 months.

Just recently the first mission, the Far Eastern Mission, under this new program that has been revived on a smaller basis, has just come back, and their report from the companies is between $15 and $20 million in sales, about a 300-to-1 leverage on the Government investment in that actual cost-shared seminar mission that had gone to the Far East.

We have demonstrated within the solar energy industry on every occasion that money has been spent on a cost-shared basis for cost going overseas, between 100- and 300-to-1 leverage return on that money in exports over a 12-month period.

Mr. **Bedell.** We will have the Department of Energy before us later. Apparently this program is being substantially cut back. Is that your understanding?

Mr. **Mead.** In 1982 the program in effect did not exist. Some of the moneys have been revived, but much smaller than the ones that we had and we are hopeful for next year.

Mr. **Bedell.** In your written testimony, which you submitted for the record, there is a paragraph which reads:

> A major cause of the trade development program—that is a Department of Commerce program, I understand—in attention to renewables is probably its incredibly low funding level. The current program funding level for TDP is $5 million. This is contrasted with comparable programs in the European community which are funded at an estimated $40 to $60 million. The comparable Japanese program is estimated to be funded at a level in excess of $100 million.

That is your testimony.

Mr. **Mead.** Yes, sir.

Mr. **Bedell.** What is that trade development program?

Mr. **Mead.** Which one, sir?

Mr. **Bedell.** Any of them.

Mr. **Mead.** I will use the Canadian example as one that is very current. The Canadians, although they have a very small industry and a very small tax base, give out $250,000 prefeasibility studies on about a 2-week notice with very little paperwork for their small companies to go into a foreign country and conduct a prefeasibility study. If that looks like a reasonable way to go, the government gives them financing, matches them up with the right set of government agencies in order to coordinate the various government resources available for them to do large demonstration projects, or set up a joint venture in these foreign countries.

What we do not do very well is coordinate all the various agencies and programs and moneys which are being in some sense of the word funneled into these areas. Sometimes we work against ourselves.

The single biggest factor our foreign competitors have on their side is that their nations and their governments have very coordinated programs. We spend a lot of money in this country, but a lot of times it doesn't get funneled into an area where the results are forthcoming and the foreign competitors do that much better.

We probably don't spend enough in the actual commercialization part of it. We probably don't spend enough on R&D either, but the commercialization part of it, we have quite an investment in the industry and yet we are spending less than $1 million a year taking people overseas and showing them the international markets. Commerce does a pretty good job, but they can only do it in the pecking order of their industries.

Mr. **Bedell**. What do you mean by the pecking order?

Mr. **Mead**. They have to worry about the very large industries, and Commerce can give a certain amount of support to the solar industry, but they can only give it on a fair share basis.

Mr. **Bedell**. How does AID fit into this?

Mr. **Mead**. That is an interesting problem. AID is very interested in renewable energy, but they are not particularly interested, it appears, in promoting American business. That is not their charter; we realize that. But there is a great role that they could play because they are in the developing nations.

The regional AID people have a large funding pot on a regional basis which they have somewhat discretionary use over, but unfortunately the AID people almost shy away from American business. We had instances where American companies have come into those countries and the AID people didn't even want to talk to them. I think this is something that ought to be changed.

Mr. **Bedell**. You talked about our trade development program in comparison with trade programs of other nations. Do you know if anybody has made a study evaluating the assistance that other countries give their renewable energy industries in export promotion compared to what we do, so we can get a better idea have to help our industry?

Mr. **Mead**. I am not aware of a single study. It is an area that the Export Council has talked about, and I think such a study would be interesting.

Mr. **Bedell**. But your belief is that even if the United States spent more money, other nations work in greater cooperation between the government and industry in making their expenditures as effective as possible. This is not the way it works in our country. Did I understand you to say that?

Mr. **Mead**. Yes, sir.

Mr. **Bedell.** What do we need to do to make our effort more effective?

Mr. **Mead.** I think we need a central coordination point so agencies like the Eximbank, AID, Department of Commerce can all understand what money they have and what efforts and charters they operate under, and to see if we can coordinate this so that industry can be a major recipient of their efforts in a coordinated fashion.

We suffer in this country from a problem that U.S. industry or U.S. Government cannot take three of four companies and unilaterally promote them overseas. Other countries like France do this. In fact, the French own many of their companies. I think the best thing we can do is to take American companies and make sure they are introduced overseas properly, and that when they come back with a proposal that they want to undertake a project that they directed to the right agency and be able to be given that opportunity without running afoul of all the paperwork.

Mr. **Bedell.** Mr. Flavin. Do you disagree?

Mr. **Flavin.** No; I agree. One thing I would add that I think is particularly important and need not cost a lot of money, in fact to some extent the staff is already in place, if we would take some of our embassy people in countries that clearly have big potential markets and see that they go about in a fairly systematic way collecting information and acting as liaisons they could be a big help to firms which travel to those countries looking for market information and commercial links.

These things cannot develop overnight. A particular person has to be in the country for some time to get to know the right people and to make the necessary contacts. Today it is generally done on an ad hoc basis. There might be someone there who is somewhat interested but he doesn't have the time to get familiar with what the photovoltaics market is or what the nature of the U.S. industry is.

Mr. **Bedell.** Thank you very much. We appreciate your testimony.

Our next panel is made up of Richard L. DiCicco from Technology Catalysts, Inc., and Ron Strathman, Western Solar Electric Systems.

PANEL CONSISTING OF RICHARD L. DiCICCO AND RON STRATHMAN

TESTIMONY OF RICHARD L. DiCICCO, PRESIDENT, TECHNOLOGY CATALYSTS, INC.

Mr. **DiCicco.** Thank you, Mr. Chairman.

In the interest of time I am just going to read a few paragraphs from my prepared statement. I have one penciled in change that I will give to you. My remarks to this committee are based on our firm's and my own expertise in the export of U.S. small business products and technology to developing countries over the past 7 years as well as sponsoring successful commercial entities in technology transfer for U.S. small business such as the high technology R&D trade fairs.

The essence of my comments focus on a specific strategy to increase exports of alternative energy products through the U.S. support of development-oriented trade fairs, which I will refer to as development technology exhibitions, which are strictly different from export trade fairs.

The reason for citing this strategy is that the market for U.S. photovoltaics is overseas, and applications using photovoltaics are in developing countries. My testimony, Mr. Chairman, cites all of the deals that were done in alternative energy and in photovoltaics, even in agriculture, at the rural development trade fair in Zimbabwe. It goes into the situations where small business was able in a country with soft currency to make deals, and those deals on the very first day of the trade fair. Those deals were made with Zimbabwean small business with profit-sharing plans for their native Zimbabwean employees. One example I would like to highlight in photovoltaics is Solar Electronics, who will be closing on a project to export solar powered two-way radios for hospitals and rural areas in Zimbabwe.

I would like to demonstrate how this technology works on a conventional radio. No batteries.

[Mr. DiCiccio holds a radio to the lights.]

Can you hear it?

Mr. BEDELL. Yes.

Mr. DICICCO. The three photovoltaic companies that were there that all made deals were Solar Electronics, Sun-Watt Systems, and Western Solar. From these examples of successful U.S. small business exports in technology transfer to developing countries, and there are many others, I have these recommendations.

One, AID should provide for the participation of U.S. small business with alternative energy products at development technology exhibitions as AT International has done in Mexico and Zimbabwe. The rationale for this is that promoting such activities for small businesses is in keeping with the AID policy statement on private enterprise development.

The regional energy adviser of AID in Kenya became very interested in cost-sharing to hold such entities at the AID mission in Kenya. He was there in Zimbabwe. There are other AID missions all over the world who have expressed interest in cost-sharing such as the mission in Ouagadougou. Four development technology exhibitions per year would create over 1,000 jobs.

Two, AID should provide a set-aside for small business to participate in development technology exhibitions in which they compete for grants that reimburse expenses to attend such events in developing countries at AID missions. The rationale is that developing country small enterprises need to see equipment; touch it; watch how it works; talk to people face-to-face, and become comfortable with the proposed deal. So do U.S. small businesses, who need to assess the market, the economy, and the people of the developing country.

This is supported in the followup questionnaires of the Zimbabwe trade fair. In our experience, development technology exhibitions provide such an opportunity, and small business is very capable to make the deals.

Three, a set-aside for small business should be introduced in the commodity import program in Zimbabwe that is earmarked for those firms participating in development technology exhibitions in that country. This program aids in soft currency problems in that it guarantees hard currency to Zimbabwe's small business for the imports of U.S. goods and services. But it is only $50 million and Solar Electronics, Bowjon, and Industrial Services International—the people at the trade fair—must compete with large U.S. companies in the commodity import program for hard currency guarantees.

Four, an intermediary organization that has the dual capability of assessing development goals of private sector development should be involved in the planning of each development technology exhibition. For example, AT International worked very closely with the AID mission in Zimbabwe to obtain local government support, thus attracting attendees in an undeveloped market. ATI also selected the most innovative technologies from small businesses to exhibit in keeping with these development goals. This is why deals were made so quickly.

The development technology exhibitions must have these four ingredients: One, prefair investigation of the market in developing countries for photovoltaics with consideration of the developing country goals.

Two, support services to help small businesses on site, as well as those not able to attend, with regard to negotiations and guidance through the maze of regulations.

Three, well-documented technical and economic data on each product at the exhibition.

Four, a plan for followup to consummate the deals which are initiated at the fair.

Finally, development technology exhibitions at AID missions is the tonic that ailing small business manufacturers of photovoltaic cells need to boost exports. The U.S. pavillion in Zimbabwe competed very successfully with the West German and the French, and according to one Zimbabwean I spoke to, "the Americans are very clever in the application of photovoltaics to world problems. We need to see more of you."

I conclude that the U.S. small business needs to see more development-oriented businesses in developing country markets.

[Mr. DiCicco's prepared statement with attachments follow:]

PREPARED STATEMENT OF RICHARD L. DICICCO, PRESIDENT, TECHNOLOGY CATALYSTS, INC.

My remarks to this committee are based on our firm's, and my own expertise, in the export of U.S. small business products and technology to developoing countries over the past seven years, as well as sponsoring successful commercial events in technology transfer for U.S. small business, such as the High Technology R&D Trade Fair. The essence of my comments focus on a specific strategy to increase exports of alternative energy products through the U.S. support of development-oriented trade fairs, to which I will refer to as Development Technology Exhibitions, which are distinctly different from Export Trade Fairs. The reason for citing this strategy, is that the market for U.S. photovoltaics is overseas, and applications using PV's are in developing countries.

I have attended the Department of Commerce's export trade fairs held in developing countries, and observed a dominant emphasis on the products of large U.S. companies which will assist in public works projects, not rural or community development. The capital intensiveness of such products tend to obscure the participation of U.S. small business in these export trade fairs. Space was sold to those companies who could afford it. In addition, no development theme is evident, and this is important to attract the attendees which set the stage for alternative energy and rural development technology transfer and exports of products using photovoltaic solar cells.

Recently I was commissioned to assist in the export and transfer of products from the U.S. small business sector at a Development Technology Exhibition supported by U.S. A.I.D. in Bulawayo, Zimbabwe. This event emphasized alternative energy products and agricultural products that would contribute to enhanced quality of life and the development objectives of the rural sector in developing countries. Nearly all of the U.S. small businesses attending and exhibiting their products either consummated deals, or are in the process of closing a deal. This illustrates that small business is very capable of negotiating their own deals in developing countries, where a development-oriented environment is set, and even in a country with soft currency and import controls. Some of these deals were joint ventures that created jobs in developing countries, as well as providing product export opportunities for U.S. small business.

Deals were even negotiated for those small firms unable to attend by the U.S. Pavilion organizers through the development of Technology Packages for their product and the use of specific technical and economic third-party consultant skills on site. The following are concrete examples of small business success.

For Bowjon International (Burbank, CA), a small manufacturer of a windmill compressor for pumping water from a source as far away as 150 feet, we successfully negotiated an option license to manufacture and export these windmills throughout the continent of Africa. The licensee was Bulawayo Platers Pvt. Ltd., a small firm with a profit sharing plan for its native Zimbabwean employees. This is a particularly appropriate deal because it helps a needy small business introduce alternative energy technology in rural areas. The President of Bulawayo Platers recently visited the U.S. to gain the technical know-how needed for assembling the windmills, as well as arranging for the import of the compressor pump from Bowjon. Plans are to make 1,100 windmills per month in Zimbabwe to export to the rest of Africa. Increased distribution in rural areas will be accomplished through a very large African company with a very large marketing force. Small business can negotiate deals of this scope with ease once they have an opportunity to show others overseas their product. More than 150 additional jobs will be created at Bulawayo Platers to handle the volume, and Bowjon will be hiring more Americans to make and export the compressor to support this increased sales volume in Africa. Very creatively, Bowjon helped this Zimbabwean small business in its marketing efforts by supplying an enormous map of wind currents for each country of Africa. This deal was consummated on the first day of the trade fair.

A second example is Solar Electronics (Summertown, TN) who will be closing on a project to export solar powered two-way radios for hospitals in rural areas in Zimbabwe. I would like to demonstrate to this committee how this technology works on a conventional radio.

In addition, 2,000 of these solar powered radios were ordered at the trade fair. Another deal to be closed shortly is supplying solar powered radio broadcast stations for education in the rural villages of Zimbabwe.

Western Solar (San Diego, CA) signed a license to export and produce a solar powered refrigerator in Botswana.

Sun-Watt Systems (Carbondale, CO) signed a joint venture for providing a Zimbabwean capability to assemble solar photovoltaic cells, leading eventually to manufacture based on an American design, and obtaining some market share in PV solar cells from France and West Germany. This is very significant, because in my observation, West German and French companies appear to dominate in photovoltaic exports to Africa. If there were more U.S. photovoltaic collectors in Africa, innovative applications, such as the radio and the refrigerator, would boost exports from U.S. small business.

On the agricultural side, the Zimbabwe Government's Department of Physical Planning is obtaining an import license for an innovative and very expensive ($5,495) tractor from Tri-Tractor Manufacturing (Marietta, GA). This company did not attend the trade fair, and the decision was made on the basis of reviewing the prepared Technology Package and receiving a technical explanation from the U.S. Pavilion organizers.

Industrial Services International (Bradenton, FL) signed several letters of intent for the export of their Terrasorb® product, which I will demonstrate to the committee.

This technology wrapped around a seed will make the seed germinate faster and result in more yield per acre. ISI's major market is overseas, and the Development Technology Exhibition gave them the opportunity to interest major European multi-national companies to import Terrasorb and re-sell it to farmers in Africa and Europe.

Finally, the Zimbabwe small business who licensed the windmill, Bulawayo Platers, has developed a low cost housing technology that it would like to license to a U.S. small business. Such examples of "reverse technology transfer" are rare from developing countries, but innovation is a global phenomenon.

From these examples of successful U.S. small business exports and technology transfer to developing countries, and there are many others, I have these recommendations:

1. U.S. A.I.D. should provide for the participation of U.S. small business with alternative energy products at Development Technology Exhibitions, as A.T. International has done in Mexico and Zimbabwe. The rationale for this is that: Promoting such activities for small business is in keeping with the A.I.D. policy statement on private enterprise development on page 8. The Regional Energy Advisor of U.S. A.I.D. in Kenya became very interested in cost-sharing to hold such events at the A.I.D. Mission in Kenya. There are other A.I.D. Missions all over the world who have also expressed interest in cost-sharing such as the Mission in Ouagadougou. Four Development Technology Exhibitions per year would create over 1,000 jobs.

2. U.S. A.I.D. should provide a setaside for small business to participate in Development Technology Exhibitions in which they compete for grants that reimburse expenses to attend such events in developing countries at A.I.D. Missions. The rationale is that developing country small enterprises need to see equipment, touch it, watch how it works, talk to people face-to-face, and become comfortable with the proposed deal. So do U.S. small businessses, who need to assess the market, the economy and the people of the developing country. This is supported in the follow-up questionnaires. In our experience Development Technology Exhibitions provide such an opportunity, and small business is very capable to make the deals.

3. A setaside for small business should be introduced in the Commodity Import Program in Zimbabwe that is earmarked for those firms participating in Development Technology Exhibitions in that country. This program aids in the soft currency problems in that it guarantees hard currency to Zimbabwe business for imports of U.S. goods and services. But it is for only $50 million. Presently Solar Electronics, Bowjon, and Industrial Services International must compete with large U.S. companies in the Commodity Import Program for hard currency guarantees.

4. An intermediary organization that has the dual capability of assessing development goals and private sector involvement should be involved in planning of each Development Technology Exhibition. For example, A.T.I. worked very closely with the A.I.D. Mission in Zimbabwe to obtain local government support thus attracting attendees in an undeveloped market. A.T.I. also selected the most innovative technologies from small business to exhibit in keeping with these development goals. That is why deals were made so quickly.

The Development Technology Exhibitions must have these ingredients:

a. Pre-fair investigation of the market in the developing country for photovoltaics (or other products), with consideration of developing country goals.

b. Support services to help small businesses on site, as well as those not able to attend, with regard to negotiation and guidance through the maze of regulations.

c. Well documented technical and economic data on each product at the exhibition.

d. A plan for follow-up to consummate deals that are initiated at the fair.

5. Development Technology Exhibitions at A.I.D. Missions is the tonic that ailing U.S. small business manufacturers of photovoltaic cells need to boost exports. The U.S. Pavilion in Zimbabwe competed very successfully with the West Germans and French, and according to one Zimbabwean I spoke to, "the Americans are very clever in the application of photovoltaics to rural problems. We need to see more of you." I conclude that U.S. small business needs to see more development-oriented businesses in developing country markets.

[For additional material submitted by Mr. DiCicco, see appendix A.]

Mr. **Bedell**. Thank you, Mr. DiCicco.

Mr. Strathman?

TESTIMONY OF RON STRATHMAN, WESTERN SOLAR ELECTRIC SYSTEMS

Mr. **Strathman**. Mr. Chairman, I would like to summarize my involvement in a photovoltaics development program in the United

States, sponsored by the U.S. Government. I can't add too much to Mr. DeCicco's comments regarding what we need to do for commercialization and marketing in the future.

My firm has been involved in a NASA-Lewis Research Center managed project for the development of a photovoltaic powered vaccine cooler for use in the United Nations/World Health Organization's expanded program on immunization.

By way of background, it has been estimated that some 70 percent of vaccines shipped to developing countries are lost in the field, and not used because of improper refrigeration or no refrigeration at all. The equipment currently available to provide refrigeration for medical supplies in developing countries, especially rural areas, depends on a constant source of electricity or a continuous supply of high quality kerosene and regular maintenance for operation.

In addition, such equipment has not been designed for operation in hot, tropical climates. Escalating fuel costs, fuel quality, maintenance and spare parts availability have proven to be a problem with existing vaccine refrigerators. So here we have an example where photovoltaics can be used.

Key personnel at WSR have been involved in the development of high efficiency refrigeration systems for the past 6 years. In 1979 it became apparent to these individuals that a relatively large worldwide market existed for small, highly efficient PV-powered DC refrigerators to replace conventional AC- and kerosene-powered units used to refrigerate food and medical supplies in developing countries.

Tooling for the present WSR unit was produced and the first preproduction prototype was manufactured in the fall of 1979. This unit was designed and tested to UN/WHO and ASHRAE performance standards, using an inhouse environmental testing chamber and WHO testing procedures required for vaccine coolers considered for use in the EPI cold chain.

A patent on this unit was applied for in 1980 and later issued. In February 1980, WSR was incorporated to manufacture this special refrigerator and the unit was placed into production. In October 1980, a RFP was issued calling for the development of a photovoltaic-powered vaccine cooler similar to the then in-production WSR unit. Eventually two contract awards were made under this program, both to major U.S. PV manufacturers. WSR has performed as a subcontractor to one of these firms.

To date, only a portion of the field testing phase of this program is complete. That is the second part of a two-part program. Now it is estimated that the units produced for the final field testing phase of the program will be installed in the field in developing countries in mid-1983, with testing scheduled to be completed in mid-1984.

This timeframe represents a total of over 4 years from the beginning of the NASA-Lewis project to develop and test a photovoltaic-powered vaccine cooler. Note that by June 1980, WSR had produced over 100 units meeting UN/WHO specifications for vaccine coolers. UN/WHO, public and private donor groups in Europe, the United States, and other developed countries, as well as health ministries worldwide have been looking to NASA-Lewis to certify as acceptable a vaccine refrigerator suitable for use in their vaccination programs. As a result, the planned procurements for vaccine coolers to be installed in existing clinics as well as those under construction in the future either have been canceled or held in abeyance until such time as the NASA-Lewis program is concluded.

The sales potential for PV-powered vaccine refrigerators has been estimated by NASA-Lewis to be 50,000 units over 5 years and 50,000 to 100,000 units over 5 to 10 years by others. Because of the delays in the project, this sales potential today remains only sales potential. It was estimated initially that the testing program would require 1 to 1½ years to complete, at which time sales could begin.

At $3,500 per system in 1982 U.S. dollars, this represents a potential export for U.S. photovoltaic module and vaccine refrigerator manufacturers of $175 to $300 million, a substantial portion of the 1981 to 1986 projected PV export sales volume. I might add that the Japanese have procured several of our units via other suppliers, have dissected them and are now asking us for bills of material, sources of supply, et cetera. Those manufacturers who have participated in the program have suffered substantial financial losses as a result of loss of sales projected to have begun in August 1981. In fact, having relied upon NASA-Lewis estimated timetable for completion of the project, WSR began costly marketing efforts in January 1981 in anticipation of the sales.

As a result, with no sales of the product, WSR was forced to file a petition for bankruptcy under chapter 11 bankruptcy in April 1982. Total revenues to WSR from this program during the entire 3-year period, including the two units purchased by NASA-Lewis immediately before the issuance of a 1980 RFP, totaled $16,533.

In the past, Government agency participation in the development of the PV industry has been well-received and valuable. Research and development activities, however, differ considerably from consumer product development and product commercialization programs.

I submit that the continued successful commercialization of photovoltaic products and systems can best be accomplished by private industry with Government support in the following areas: Direct private sector involvement and demonstration project education, definition and implementation. Direct funding to private sector interests on an as needed basis for all commercialization activities undertaken in the marketplace. Increased opportunities for U.S. business interests to gain foreign exposure via demonstration programs in developing countries implemented by business with U.S. Government support. Trade exhibitions, technical seminars, workshops and participation by business interests in developing countries funded on an as needed basis by U.S. Government agencies.

My firm participated in the AID-funded exhibition in Zimbabwe several months ago, and the return on my investment, the expenditures that WSR made to attend that show have been something like 50 times what we spent to get there, and by the end of the first quarter 1983 it should be in excess of 150 times the expenditure made to get WSR to Zimbabwe.

Thank you, Mr. Chairman.

[Mr. Strathman's prepared statement follows:]

PREPARED STATEMENT OF RON STRATHMAN, WESTERN SOLAR ELECTRIC SYSTEMS

Western Solar Refrigeration (WSR) has been involved in the NASA-Lewis project for the development of a photovoltaic powered vaccine cooler for use in the United Nations/World Health Organization's (UNWHO) Expanded Programme On Immunization (EPI).

The following is a description of the EPI program and the reasons for the development of an improved method for storing vaccines in remote health clinics:

Millions of people live in rural areas where primary health care delivery is rudimentary at best, exposing the population to a plethora of infectious diseases. Because these diseases flourish at the poverty level, they are important indicators of a state of potential ill health.

Vaccination as a means of preventing a number of these diseases such as poliomyelitis, small pox, diptheria and measles, has been used extensively in developed countries for several decades. The experience gained is being transferred gradually to more and more remote areas. But, the introduction of vaccination programs and medical care in general into rural areas of developing countries has been subject to a number of economic, operational, and technololgical problems. One of the key, critical problems facing those conducting these immunization projects is the one of maintaining vaccines at a safe temperature (4-10 degrees C) up to the time of administration to the patient. Vaccines must be refrigerated throughout the distribution system, from the manufacturer to the actual site. Vaccines exposed to excessive temperatures suffer a permanent loss of potency.

The equipment previously available to provide refrigeration for medical supplies depends on a constant source of electricity or a continuous supply of high quality kerosene and regular maintenance for operation. In addition, such equipment has not been designed for operation in hot, tropical climates. Escalating fuel costs, fuel quality, maintenance, and spare parts availability have proven to be a continuing problem with existing vaccine refrigerators.

In 1979 WSR designed a medical refrigerator/freezer based upon WHO/CDC specifications for the refrigeration of vaccines in the "cold-chain" for use in remote primary health clinics in developing countries. Because of the unit's extreme efficiency, it can operate away from commercial power sources on solar electric power. Basic design criteria for the unit were low power consumption, long life and reliability, ease of installation—those features which must be incorporated into a product which is used in tropical, remote areas of the world. The unit uses a combination of internal thermal and battery storage to provide for operation during periods of no sun days such as during severe storms or very heavy overcast. In addition, the photovoltaic array will produce usable amounts of electricity during periods of mild overcast. With four 100 ampere hour storage batteries, 20 days or more of no sun can be tolerated without losing safe internal storage temperatures in the refrigerator. This refrigerator/freezer is not in adaptation of a domestic product but rather specifically designed for use in remote medical clinics for the storage of vaccines.

Key personnel at WSR have been involved in the development of high efficiency refrigeration systems for the past six years. In 1979 it became apparent to these individuals that a large, worldwide market existed for small, highly efficient, photovoltaic powered DC refrigerators to replace conventional AC and kerosene powered units used to refrigerate food and medical supplies in developing countries. Tooling for the present WSR refrigerator was produced and the first pre-production prototype was made in the fall of 1979. This unit was designed and tested to UNWHO and ASHRAE performance standards using an in house environmental testing chamber and WHO testing procedures required for vaccine coolers considered for use in the EPI "cold-chain." A patent on this unit was applied for in January of 1980 which was later issued. In February 1980, WSR was incorporated to manufacture this special refrigerator and the unit was placed into production.

Soon it was determined that CDC and NASA-Lewis personnel were preparing an RFP for the development of small refrigeration units like the unit in production at WSR. NASA-Lewis issued the RFP during first quarter 1980, but it was later withdrawn as the performance requirements specified were well beyond the capability of current refrigeration technology. NASA-Lewis was made aware of the WSR unit; two of them, production units 102 and 103, were purchased by NASA-Lewis for evaluation. After three months of evaluation, a revised RFP was issued more in line with the capabilities of current DC refrigeration technology. The specifications in the second RFP were nearly the same as the specifications for the WSR production unit. This RFP issued in October of 1980 and went out to over 50 manufacturers of refrigeration products in the U.S. NASA-Lewis personnel strongly recommended to WSR that the company bid the contract jointly with Motorola, with Motorola acting as prime contractor. Eventually two contract awards were made, both to major U.S. photovoltaic module manufacturers. Each contract called for the production of one unit for laboratory testing and up to 50 units to be produced for field testing under a follow-on contract to be issued at the conclusion of the initial testing phase, estimated to be August 1981. To date a follow-on contract for the production of twenty systems has been awarded to one participant in the initial contract. Acquisition of another ten systems from the second photovoltaic module manufacturer currently is in progress. Now it is estimated that the units produced for the final field testing phase will be installed in mid 1983 with testing scheduled to be completed in mid 1984. This time frame represents a total of over four years from the beginning of the NASA-Lewis project to develop and test a photovoltaic powered vaccine cooler. Note that by June 1980, WSR had produced over 100 units which met UNWHO specifications for vaccine coolers.

Many developing countries have been participaing in the UNWHO EPI program for a number of years. Health clinics in remote areas have been constructed or scheduled for construction, vaccinators have been trained and the infrastructure established to manage nationwide immunization programs. Refrigerated delivery trucks, regional refrigerated storage depots, warehousing procedures and training programs for personnel involved in vaccine distribution and dissemination have been in effect or are being implemented as part of the EPI program to immunize all children of the world by 1980. The weak link in the "cold-chain" is the ability to reliably store vaccine in a potent state at the point of immunization, the remote primary health clinic. UNWHO, public and private donor groups in Europe, the U.S. and other developed countries, and health ministries worldwide have been looking to NASA-Lewis to certify as acceptable a vaccine refrigerator suitable for use in their vaccination programs. As a result, the planned procurements for vaccine coolers to be installed in existing clinics as well as those under construction in the future either have been cancelled or held in abeyance until such time as the NASA-Lewis program is concluded.

It should be noted that this program has received wide visibility by means of an extensive news release campaign conducted by NASA-Lewis. Additionally, NASA-Lewis personnel have been in contact with many health ministries world wide for the past several years regarding this program. In at least two cases, NASA-Lewis recommended that a specific procurement of WSR solar powered vaccine refrigerators be held in abeyance until the completion of the development project. Further, in two additional cases, NASA-Lewis informed purchasing agencies who were negotiating with WSR for substantial purchases of vaccine coolers that these agencies were targeted for donations under the program, thus causing the sale to fall through.

The sales potential for photovoltaic powered vaccine refrigerators has been estimated by NASA-Lewis to be 50,000 over five years, and 50,000 to 10,000 by others over five to ten years. Because of the delays in the project, this sales potential remain only potential. It was estimated initially that the testing program would require 1 to 1½ years to complete at which time sales could begin. At $3,500 per system (1982 dollars) this represents a potential export for U.S. photovoltaic module and vaccine refrigerator manufacturers of 175 to 350 million dollars, a substantial portion of the 1981 to 1986 projected U.S. photovoltaic export sales volume.

It was recognized in late 1980 that the sales projections which were the basis for the WSR business plan would not be met considering the NASA-Lewis involvement in the refrigerator marketing program. A two part plan to ensure the survival of WSR was designed. The first called for raising capital for WSR to support sales efforts and operations for the duration of the NASA-Lewis testing and field programs. This effort basically was unsuccessful as venture capitalists criteria generally rejected a project which depended upon government approval of the product for market acceptance. The second part involved the formulation of a market plan designed to counter the resistance to sales because of the NASA-Lewis involvement in the project, at that time a credible testing agency. WSR participated in a number of AID, DOE and DOC sponsored renewable energy and rural development trade fairs and catalog exhibits. Success was achieved in gaining exposure for the company and the product, however the problem of resistance to sales because of the lack of certification could not be overcome in most cases. Efforts have been undertaken also to contact AID, WHO, Red Cross, and other PVO field operatives involved with immunization delivery in rural areas of developing countries. Lack of availability of suitable vaccine refrigerators in the field has resulted in a number of purchase requisitions coming to WSR through various purchasing agencies.

Even though U.S. government supported marketing programs have been a great help for WSR in achieving sales goals, significant sales of the vaccine cooler still do not exist. For example, a recent AID sponsored exposition in Zimbabwe was very successful for WSR in terms of exposure and establishing a distributor who immediately began to negotiate significant sales of photovoltaic powered vaccine coolers throughout SAADC countries. But shortly after the exposition the Chief Technical Officer for the WHO EPI visited Zimbabwe and told the distributor and his buyer (Save The Children) that the WSR vaccine cooler had not yet been approved for use in the EPI programs.

Because of delays in the completion of both the initial development and laboratory testing phase of the program and the yet to be completed field testing phase, the development project has suffered a severe loss of credibility with UNWHO and others monitoring the program. A significant competitive edge has been given to foreign manufacturers of similar vaccine cooling equipment and systems. Additionally, those manufacturers who have participated in the program have suffered substantial financial losses as a result of loss of sales projected to have begun in August of 1981. In fact, having relied upon NSA-Lewis's estimated timetable, WSR began costly marketing efforts in January of 1981 in anticipation of these sales, but as a result of no sales was forced to file a Bankruptcy Petition for Chapter 11 Reorganization in April 1982. Total revenues to WSR from this program during the entire period, including the two units purchased by NASA-Lewis for evaluation, have been $16,533.

In the past, government agency participation in the development of the photovoltaics industry has been received well by industry. Research and development activities, however, differ considerably from product development and product commercialization programs. The continued successful commercialization of photovoltaic products and systems can be best accomplished by private industry with government support in the following areas: direct private sector involvement in project identification, definition and implementation; direct funding to private sector interests for all commercialization activities undertaken in the marketplace; increased opportunities for U.S. business interests to gain foreign exposure via demonstration programs in developing countries implemented by business with government support; trade exhibitions and technical seminar attendance, work shop formation and participation by business interests funded on an as needed basis by government; arranging for key government officials in developing countries involved in equipment acquisition to visit U.S. manufacturing facilities, tour demonstration projects, and attend technical seminars, and, develop programs to provide interested U.S. firms timely copies of reports on studies and development programs undertaken by government agencies which may affect or enable increased U.S. exports.

Mr. Bedell. Thank you, Mr. Strathman.

Mr. DiCicco, you have participated in trade shows represented both by the Department of Commerce and the Agency for International Development.

Mr. DiCicco. That is correct.

Mr. Bedell. Can you tell us the difference in the character of those shows?

Mr. DiCicco. Yes; the Department of Commerce exhibitions, which I will call export trade fairs, essentially sell space to industry, and the ones that I have attended will display a huge piece of earthmoving equipment which is obviously very capital-intensive and really out of the reach of small business.

The aim is public works, and there is no assessment of the development goals of a developing country if that trade fair is held in that developing country. Commerce is not set up to do that. So they sell space, and oftentimes small businesses cannot afford to purchase that space at these Department of Commerce trade fairs.

They also don't reimburse the travel it takes to get to that developing country. It costs about $2,800 for a round trip ticket on the east coast to get to Zimbabwe, and that is a large expenditure for many small businesses. The difference between what Commerce's fairs are like and the development technology exhibitions both in Mexico and in Zimbabwe is that small business is represented 100 percent.

They are reimbursed for their expenses to get there, so the initial risk is minimized. The deals that are made occur when the small businesses that are there see the equipment and become comfortable with the provider of the technology. A lot of homework was done by AID for the Zimbabwe trade fair that made it a success.

Mr. BEDELL. Apparently the Zimbabwe fair was a success as judged by the U.S. small businesses who participated?

Mr. DICICCO. Yes. It was a tremendous success for the photovoltaic companies that attended as well.

Mr. BEDELL. And apparently you feel that for small business the trade fairs that have been conducted by AID have been more effective than the Commerce trade fairs for small business?

Mr. DICICCO. Most definitely, Mr. Chairman.

Mr. BEDELL. Mr. Strathman, I didn't quite understand you. Did your company go bankrupt before or after you went to Zimbabwe? You indicated the fair in Zimbabwe was a great success for you, but that you have gone bankrupt. I don't understand that.

Mr. STRATHMAN. My firm filed chapter 11 bankruptcy, but is still in business.

Mr. BEDELL. You said you submitted one of your refrigeration units to NASA. If I understood your testimony, you indicated that NASA is involved in a big project trying to produce something that you are already producing. Is that right?

Mr. STRATHMAN. Yes, sir.

Mr. BEDELL. Did you say they have bought two of your units?

Mr. STRATHMAN. NASA-Lewis issued an RFP in early 1980——

Mr. BEDELL. What is a RFP?

Mr. STRATHMAN. A request for proposal. This RFP went to various PV manufacturers and refrigerator manufacturers to secure a firm interested in developing a cooler for vaccine in developing countries.

Mr. BEDELL. Did you already have one developed?

Mr. STRATHMAN. Yes. The RFP was not consistent with current or future refrigerator technology. It was withdrawn and reissued in October 1980, 7 months later. Just before, however, the RFP was issued, two of our units were purchased and evaluated to NASA, specifications were changed to more closely resemble the unit that we were in production with, and then the RFP was issued.

Mr. BEDELL. Were they proposing something beyond what your units did?

Mr. STRATHMAN. The unit was about 98 percent what we had in production at that time. There were several smaller peripheral changes that they required.

Mr. BEDELL. If you already had one in production, why did they try to find someone to build what you already had?

Mr. STRATHMAN. That would be a good question for NASA-Lewis personnel.

Mr. BEDELL. It is a legitimate question.

Mr. STRATHMAN. That question has never been answered to my satisfaction.

Mr. BEDELL. What does NASA-Lewis mean?

Mr. STRATHMAN. Lewis refers to NASA's research center in Cleveland, Ohio; it is the name of the particular installation.

Mr. **Bedell**. Without objection, I think that we should ask our staff to contact them and ask them why this was done.

[For additional information, see app. B.]

Mr. **Strathman**. A procurement contract would have been more in order rather than a development contract.

Mr. **Bedell**. We are running out of time here. There are some questions I would like to have asked, but we have two more panels yet, and we are supposed to be finished by 4 p.m. Thank you very much.

Our next panel will consist of Joseph Tribble, Assistant Secretary for Conservation and Renewable Energy, the Department of Energy, Jack Vanderryn, Director for Energy and Natural Resources, Agency for International Development, and Donald Earnshaw, Deputy Assistant Secretary for Export Development, International Trade Agency, the Department of Commerce.

Mr. Conte asked me to say that he had hoped to be present at least for this portion of the hearing but he has to be on the floor to manage an appropriations bill. Before we start, have all you people been here for the whole hearing?

Mr. **Earnshaw**. No, I came about 2 o'clock this afternoon.

Mr. **Bedell**. I want to commend you, Mr. Tribble. One of the complaints I often hear is that we have people from the administration who give their testimony and leave without having the advantage of hearing what other people have had to say. I think it speaks very well of you to have been here for the full hearing. We may have differences on some issues, but I appreciate the fact that you have been here. Do you want to proceed first?

PANEL CONSISTING OF JOSEPH J. TRIBBLE; DONALD EARNSHAW; AND DR. JACK VANDERRYN

TESTIMONY OF JOSEPH J. TRIBBLE, ASSISTANT SECRETARY FOR CONSERVATION AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY

Mr. **Tribble**. Mr. Chairman, inasmuch as the testimony has been submitted in its entirety for the record, I would like to merely summarize briefly, particularly in view of the time constraint.

Mr. **Bedell**. I appreciate that very much. Your entire testimony will be made a part of the record.

Mr. **Tribble**. I appreciate the opportunity to discuss with you today the Department of Energy's role in the development of photovoltaic energy. In the earlier years of this program the majority of the appropriated amounts were used for activities other than research.

A number of facilities were built to demonstrate the technical feasibility of the photovoltaic process for terrestrial use and also to serve as test beds for collection of data and identification of problems.

Some of these installations have already served their purposes and are being disposed of. Others continue in the data collection and evaluation phase. The program is now being directed toward the solution of the problems that have been identified. The DOE program currently pursues two basic research strategies to advance the state of the art in photovoltaics.

The first research area focuses on techniques and materials that have shown promise reducing PV module cost through the use of low-cost materials while maintaining an adequate conversion efficiency. Materials under examination include amorphous silicon, gallium arsenide, and copper indium diselenide.

The second research area emphasizes achieving maximum photovoltaic efficiencies by reducing fundamental losses in the solar cell. One loss in efficiency is related to a material's ability to absorb only one level of energy from photons. By guiding the solar spectrum into energy bands and optimizing solar cells for each, significant higher efficiencies can be achieved with combinations of these cells.

Research will lead to projected efficiencies on the order of 39 percent for these multiband gap or stacked cells. We are also seeking to learn more of the theory involved in direct conversion of light to electricity.

In support of these two research strategies, the program conducts basic materials research and measurement activities. Measurement techniques will be developed to help understand the stability of thin film compounds and amorphous materials and to identify primary degradation mechanisms.

The Department of Energy has a memorandum of understanding with the Department of Commerce whereby funds are transmitted from DOE to the Department of Commerce for the purpose of a cooperative interagency effort for the exhibition and international trade promotion of renewable energy systems.

Finally, the Department of Energy has an Office of Small and Disadvantaged Business Utilization. Plaques were awarded to offices within the agency which exceeded their goals in assisting small and disadvantaged businesses through procurements. The Office of Conservation and Renewable Energy was one of the recipients of this award in 1981, and we fully intend to qualify in 1982.

Mr. Chairman, that concludes a summary of my testimony. I will be pleased to try to answer your questions.

[Mr. Tribble's prepared statement follows:]

PREPARED STATEMENT OF JOSEPH J. TRIBBLE, ASSISTANT SECRETARY FOR CONSERVATION AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY

Thank you for this opportunity to appear before you today to discuss the development of photovoltaic energy. As the Department of Energy's Assistant Secretary for Conservation and Renewable Energy, it is my responsibility to oversee the Department's renewable energy program, which includes solar energy, alcohol fuels, geothermal, and hydropower. The Federal photovoltaics effort is of course a part of the Solar Energy Program.

My purposes today are to describe the activities of the photovoltaic energy program at the Department of Energy, to outline the important role small businesses have played and are playing in advancing photovoltaic technology, and to note DOE participation in a DOC program designed to advance international trade opportunities.

A number of topics related to "marketing opportunities" being examined by the committee are not directly part of the DOE program. However, we at DOE maintain a dialog with industry since this information provides important feedback for our R&D efforts. Therefore, we do work closely with industry to ensure that DOE's efforts are compatible with, rather than duplicative of, those of researchers, developers, and entrepreneurs in the PV industry.

DOE PHOTOVOLTAICS PROGRAM

Photovoltaics is the direct conversion of light into electrical power. Photovoltaic technology can be used to supply electricity from sunlight for small remote applications or for homes, commercial buildings, industry, or to generate electricity for utilities. Its application will depend primarily upon economic factors.

As recently as 1975, there were very few manufacturers of silicon photovoltaic modules for terrestrial applications and no manufacturers of total photovoltaic energy systems. System efficiencies were about 6 percent and prices were as high as $100 per peak watt.

Since that time, significant R&D progress has been made. The efficiency of silicon photovoltaic modules has doubled, and exceeds 10 percent. Silicon modules are now available for under $10 per peak watt. The efficiency of commercial cells has been increased from about 7 to 14 percent. The operational and lifetime reliabilities have been improved approximately tenfold, and at the same time, the cost of arrays has been reduced by a factor of five. Moreover, the number of photovoltaic producers has increased from a few specialty companies using expensive manual production processes, to more than 15 manufacturers, many of which use semiautomated pilot production lines to serve the growing market.

The DOE program currently pursues two basic research strategics to advance the state-of-the-art in photovoltaics. The first research area focuses on techniques and materials that have shown promise in reducing PV module cost through the use of low-cost materials, while maintaining an adequate conversion efficiency. Materials under examination include amorphous silicon, gallium arsenide, and cooper indium diselenide.

Amorphous silicon is an unusual composition of silicon and hydrogen. It has optical and transport properties that permit photovoltaic cells to be made approximately one micron in thickness compared to the already-developed, crystalline silicon cells which require approximately 200 microns for the same efficiency. Photovoltaic material requirements and costs will be significantly reduced if amorphous silicon research is successful. Industry recently produced the world's first amorphous silicon cell with an efficiency of over 10 percent. An efficiency of 14 percent will result in cells competitive with today's products. Research efforts in this area also concentrate on characterizing new thin-film materials composed of gallium arsenide and copper indium diselinide.

The second research area emphasizes achieving maximum photovoltaic efficiencies by reducing certain fundamental losses in the solar cell. One loss in efficiency is related to a material's ability to absorb only one level of energy, known as the "bandgap energy," from photons. Photons with less than this amount of energy are lost, whereas any excess energy above the bandgap level is dissipated as heat, not electricity. Other fundamental losses include temperature-dependent open-circuit voltages, fill factors, optical losses, photocarrier collection losses and electrical mismatch losses. As a result of the above loss factors, single junction solar cells are limited to efficiencies between 23 and 28 percent depending on optical concentration. By dividing the solar spectrum into energy bands and optimizing solar cells for each energy band, significantly higher efficiencies can be achieved with combinations of these cells, kown as multibandgap cells. This occurs because more photons are absorbed and less photon energy is lost. Successful research in this area will lead to projected efficiencies of up to 39 percent for the multibandgap or stacked cells.

Finally, in support of the two research strategies, the program conducts basic materials research and measurement activities. These efforts provide improved techniques for measuring material and device properties, including development of a methodology and interpretation technique for accelerated lifetime testing. Measurement technique will be developed to understand the stability of thin-film compounds and amorphous materials and to identify primary degradation mechanisms. Models to predict output characteristics of concentrator array subsystems will be developed and accelerated life-test models for silicon modules will be validated. Research or improved methods of examining semi-conductor, metal and insulator surfaces are also being performed.

OTHER RELATED ACTIVITIES

There are programs and policies outside the R&D activities which can enhance the development of both domestic and international markets for renewable energy. The most critical element of the administration's renewable energy policy is that market development be driven by the economics of letting the free market determine the price and consumption of energy. Within this policy framework, the administration has taken significant actions to assist in opening the frontier for a strong and viable private sector photovoltaics market. The price decontrol of petroleum and ongoing price decontrol of natural gas have effectively removed subsidies from competing fuels.

The transition of renewable technologies, including PV, from R&D to commercialization is also being facilitated through Federal tax policy. Whereas the DOE photovoltaics program provides direct support for long-term, high risk, high payoff R&D, incentives for businesses to pursue nearer-term R&D and to develop market opportunities, are enhanced by overall tax and economic programs. For example, photovoltaic systems are currently eligible for the 40 percent residential energy credit and a 15 percent investment tax credit enacted in the Windfall Profits Tax Act of 1980. Further, a number of incentives are contained in the Economic Recovery Tax Act of 1981. Those pertinent to companies in the photovoltaics industry include the R&D tax credit; depreciation allowances; the rehabilitation tax credit; and more liberal leasing provisions.

The recently enacted Small Business Innovation Development Act promises to stimulate technological innovation while using small businesses to meet Federal R&D needs. DOE will be issuing a program solicitation shortly, and photovoltaics will be one of the topics for which proposals may be submitted.

In addition to domestic incentives, Mr. Donald Earnshaw, Deputy Assistant Secretary, Export Development, Department of Commerce, has previously discussed a number of incentives and activities designed to promote international trade which are especially applicable to photovoltaics since PV energy costs tend to be very competitive with conventional systems in many international markets.

The development of renewable energy products, including photovoltaics, cannot depend solely on Federal R&D and incentive provisions. The industrial sector has the responsibility to continue and enhance R&D concepts developed from Federal support by bringing products to the marketplace through development of methods to manufacture and sell products at competitive energy prices, and through development of approaches for penetrating the market.

RENEWABLE ENERGY AND SMALL BUSINESS

Renewable energy systems encompass several energy conversion technologies, and many system options and applications, ranging from small-scale, dispersed uses to large-scale, central station facilities. This broad spectrum of renewable resource technologies, sizes and options provides a number of opportunities in areas of research, production and commercial applications. As the industry expands through improved techniques and greater user acceptance, the picture for small business participation in renewable energy development and commercialization looks very promising.

With respect to the Federal program for which I am responsible, each renewable energy technology participates in the DOE small and minority business program to assure that such businesses are afforded adequate contract opportunities. For photovoltaics, in particular, we have encouraged the continued participation of small business in this program by ensuring that a portion of Federal funding is awarded to qualified small firms. In fiscal year 1982, for example, approximately 20 percent of photovoltaic contracted funds went to small businesses. The results are especially encouraging, as several important R&D advances have been provided by small business firms participating in photovoltaics research under the auspices of the DOE program.

For example, a small firm in Massachusetts developed, under DOE sponsorship, a unique method for creating the electrical junction in silicon solar cells.

This method is suitable for high-volume manufacturing and significantly reduces mass production costs. Other contributions made by small businesses include the development of a heat exchanger method for casting silicon ingots—casting rather than growing ingots can greatly reduce costs—and development of the fastest known method for pulling (or growing) silicon sheet.

The DOE sponsored R&D has also helped some small companies become large companies. One small company that worked with DOE on PV research has since been able to attract outside investment. This firm now employs over 500 people.

Through Federal efforts as well as competitive forces in the economy, significant opportunities for small business participation in the PV industry are continuing and expanding. This participation includes all activity areas such as R&D, new product development, ancillary materials and products support, systems design and construction, systems maintenance, and recycling of materials.

By identifying photovoltaics technology options, Federal R&D activities, as well as incentives such as energy price decontrol, have aided business development and investment in this industry. The DOE PV program will continue to emphasize R&D addressing new and advanced concepts. These R&D activities should enhance the emerging U.S. PV energy industry efforts to maintain the technology advantage that it currently enjoys over international competition. Program activities also continue to provide opportunities for significant small business participation.

Mr. **Bedell**. Thank you. I appreciate very much the way you summarized your statement, Mr. Tribble.

[For additional information see appendix C.]

Why don't we hear from Mr. Vanderryn from AID next.

TESTIMONY OF DR. JACK VANDERRYN, DIRECTOR FOR ENERGY AND NATURAL RESOURCES, AGENCY FOR INTERNATIONAL DEVELOPMENT; ACCOMPANIED BY MS. BARBARA OTIS, DIRECTOR, OFFICE OF SMALL AND DISADVANTAGED BUSINESS UTILIZATION, BUREAU OF PRIVATE ENTERPRISE, AID

Mr. **Vanderryn**. Thank you, Mr. Chairman.

I would also like to introduce to my right, Barbara Otis, Director of our Office of Small and Disadvantaged Business Utilization in our Bureau of Private Enterprise, AID.

Mr. Chairman, I request that my full statement be placed into the record and I will try to briefly summarize it. I am pleased to appear before you today as Agency Director for Energy and Natural Resources to discuss AID activities which help promote the use of renewable energy technologies in developing countries and help create markets for U.S. small business.

AID's long-term goals are to ease the immediate constraints to development caused by the high cost of imported oil and help developing countries make the difficult transition to a mix of energy sources that will sustain their economies. Our programs are tailored to the needs of individual countries and we seek to stimulate investment and involvement of the United States and Third World private sectors.

Renewable energy technologies represent a new option for meeting energy demands in LDC's. Many critical questions on how best to identify and integrate renewable resources into individual country energy supply systems have yet to be answered. A major part of AID's effort is dedicated to helping developing countries understand how they can best use their own energy resources and what organizational structures and systems must be developed. We are thus focusing on identifying the most important uses of energy and then testing technologies with the greatest potential to meet these requirements. AID has taken several steps to insure that the interests of U.S. private industry are met. Small businesses have played a large role in AID's renewable energy activities because in many areas, they represent the largest base of expertise.

We have demonstrated the performance and reliability of U.S. renewable energy technology in a number of developing country situations. Small businesses have played a significant role in this.

AID programs will increasingly be concerned with proving the commercial viability of renewable energy technologies. This step will rely on the continued active involvement of U.S. industry.

With respect to photovoltaics, AID has for some time recognized the potential of Third World markets for U.S. photovoltaic systems. As has been previously indicated, they are particularly suitable for low-power applications in locations inaccessible to a central electricity grid.

AID has financed the field testing of photovoltaic applications in a number of Third World countries to obtain information on how this technology can realize its potential. Our projects produce information on the economic, technical, social, and infrastructure aspects of the applications, and provide better knowledge to the indigenous and private sector, host countries, and AID to judge the benefits and risks of using this and other renewable energy technologies.

During the past 4 years we have been evaluating the ability of photovoltaic technology to meet rural electricity needs in the developing world. We have committed $4.4 million to this since 1979, using as our project manager the NASA Lewis Research Center in Cleveland, a pioneer in photovoltaic R&D since 1960.

In our initial pilot project we installed a 1.8 kilowatt photovoltaic unit to power a water pump and small grain mill in an Upper Volta village. Equipment procurement and assembly involved a number of U.S. suppliers, many of which were small business firms.

NASA's field tests enabled the manufacturers to modify system components and significantly improve their reliability. We believe that with increased volume, mechanization and further technological advances expected to result in lower prices, photovoltaics should be increasingly competitive in remote locations as costs for electricity generated from fossil fuels continue to rise.

In Tunisia, we soon expect to operate a photovoltaic power system integrated with wind and solar heating units. In this project, cost shared with the Government of Tunisia, the Solar Power Corp. of Woburn, Mass., is installing a 10- to 20-kilowatt system to meet domestic and commercial needs in the village. At another remote Tunisian site, two 600-watt systems will provide power for drip irrigation in a greenhouse, and orchard. About one-quarter of the procurement in this $880,000 experimental program has been from U.S. small business. As a matter of fact, some of the project is being costshared by the prime and small business subcontractors themselves, and this certainly indicates a private sector interest in this area of activity.

As has already been mentioned, at a number of remote sites in developing countries, AID is supporting, together with the Department of Energy and the Department of Health and Human Services, field tests of photovoltaic-powered refrigerators for the preservation of vaccines.

Under bid the Lewis Center purchased 10 units from Solar Power Corp., and negotiations for purchase of 10 units from Solavolt International are underway. Eleven percent of the procurement for the Solar Power contract was from small business, and 35 percent of the Solavolt contract, is expected to be from small business.

AID has funded photovoltaic-powered electricity supplies for five rural health clinics in Ecuador, Guyana, Kenya, and Zimbabwe. These health clinics are well-suited to photovoltaic power since they require modest amounts of electricity from a reliable source.

Other AID projects have investigated applications of photovoltaic power. In Botswana, we have purchased medical refrigerators and we are looking at photovoltaics for water pumps to provide the power to them. In Mali we are also field testing photovoltaic-powered pumps, refrigerators, and lighting as part of a 5-year, $4 million project.

Our mission in Niger is procuring a pump from Solar Electric International of Maryland, which is a small firm, to function with a photovoltaic array from Solarex. In Nepal, we have used photovoltaics to power radios in rural areas. In India, the Jet Propulsion Laboratory is using a photovoltaic array in a village project.

Another interesting application is that photovoltaics, in combination with diesel generators, are expected to provide energy for ground stations receiving satellite communications.

Mr. Chairman, my testimony also mentions a number of activities such as our training programs, for example, in renewable energy at the University of Florida, and our energy management program at Stonybrook, in New York, which has provided an opportunity for senior and mid-career energy level officials from over 40 developing countries to meet with U.S. industrial firms, including a photovoltaic manufacturer, for various briefings and discussion of technology transfer. Such interactions provide very useful contacts for our industry with senior level officials in developing countries.

There are a number of other renewable energy areas which are mentioned in my testimony where we have involved U.S. small business. In the small hydropower area, we recently sponsored a workshop involving a number of U.S. small business firms to discuss with them the AID programs and to learn from them how we can more closely cooperate with U.S. industry to further both AID's interests, as well as U.S. industry interests. We are further exploring interactions between AID and other components of the U.S. renewable energy meetings.

We have in mind sponsoring other missions similar to this small hydropower workshop to discuss our programs with representatives of U.S. industry to develop mutually beneficial activities which meet our development assistance goals.

We are also in close contact with the International Trade Administration of the Department of Commerce, to help assure that their export promotion activities take full account of our experiences and knowledge of the LDC environment, as well as our program interests and projects.

AID provided funding for two regional development technology exhibitions in Mexico City and in Zimbabwe. In theory, such exhibitions provide a good means to share technology, encourage development of new trading arrangements, and stimulate the private sector in developing countries. These exhibitions were an experiment for AID. Further involvement in such innovative expositions, perhaps in cooperation with the Department of Commerce, will await the outcome of our more detailed evaluation of the two exhibitions.

In summary, through its technical assistance programs in energy which are directed at addressing the development needs of the LDC's, AID supports U.S. private sector interests and actively includes those of the small business community. This is done in a broad and diverse number of ways:

One, direct involvement of U.S. industry in AID development assistance. This makes use of U.S. industrial know-how to help the LDC's solve their energy problems, and provides our industry opportunities to become familiar with developing country markets. Hardware and technical consultants for AID-funded projects are procured from U.S. suppliers. Small business firms have often received contracts, especially in renewable energy activities.

Two, workshops and conferences funded by AID provide new contacts between U.S. industry and developing country energy personnel.

Three, AID projects test U.S. energy products in developing countries to obtain information on how they can most effectively satisfy Third World requirements.

Four, developing country markets for renewable energy technologies are identified in the course of the Agency's technical assistance programs. This information is provided to U.S. industry.

Five, training programs in renewable energy technologies establish contacts between the LDC participants, who are often key Government agency officials, and U.S. industrial representatives.

Six, directories, catalogs, and specifications of American-made equipment are circulated to developing countries by AID and its contractors.

Renewable energy technologies, including photovoltaics, will play an increasing role in developing countries, over time. Small businesses constitute a significant fraction of the renewable energy industry. AID's activities offer encouragement and support to our industry in gaining access to the developing country market.

Thank you.

Mr. BEDELL. Thank you very much, Mr. Vanderryn.

[For additional information, see appendix D.]

[Dr. Vanderryn's prepared statement follows:]

PREPARED STATEMENT OF DR. JACK VANDERRYN, DIRECTOR FOR ENERGY AND NATURAL RESOURCES, AGENCY FOR INTERNATIONAL DEVELOPMENT

INTRODUCTION

I am pleased to appear before you today as Agency Director for Energy and Natural Resources to discuss AID activities, which help promote the use of renewable energy technologies in developing countries and help create markets for U.S. small business.

AID's long-term goals are to ease the immediate constraints to development caused by the high cost of imported oil and help developing countries make the difficult transition to a mix of energy sources that will sustain their economies. Our programs are tailored to the needs of individual countries and we seek to stimulate investment and involvement of the U.S. and Third World private sectors.

Renewable energy technologies represent a new option for meeting energy demands in LDC's. Because of their newness, many critical questions on how best to identify and integrate renewable resources into individual country energy supply systems have yet to be answered. A major part of AID's effort is dedicated to helping developing countries understand how they can best use their own energy resources and what organizational structures and systems must be developed. We are thus focusing on identifying the most important uses of energy, and then testing technologies with the greatest potential to meet these requirements. Our goal is to help the developing countries make their future energy system choices and develop the countries make their future energy system choices and develop the infrastructure required to implement their decisions.

Understanding how to integrate renewables into existing structures furthers AID's development goals, and provides invaluable information to indigenous as well as U.S. industries, both large and small, about the potential market, and how to address it.

AID has taken several steps to ensure that the interests of U.S. private industry are met. Small businesses have played a large role in AID's renewable energy activities because in many areas they represent the largest base of expertise. Their involvement is leading to the development of technologies responsive to developing country needs.

We have demonstrated the performance and reliability of U.S. renewable energy technology in a number of developing country situations and other tests are underway. Small businesses have played a significant role in this.

AID programs will increasingly be concerned with proving the commercial viability of renewable energy technologies. This step will rely on the continued active involvement of U.S. industry.

With respect to photovoltaics, AID has for some time recognized the potential of Third World markets for U.S. photovoltaic systems. As has been previously indicated, they are particularly suitable for low-power applications in locations not accessible to a central electricity grid. As has been pointed out in earlier hearings, developing countries appear to represent the largest potential market for U.S. photovoltaic manufacturers.

AID has financed the field testing of photovoltaic applications in a number of Third World countries to obtain information on how this technology can realize its potential for meeting key end use requirements. Our projects produce information on the economic, technical, social and infrastructure aspects of the applications, and provide better knowledge to the indigenous and private sector, host countries and AID to judge the benefits and risks of using this and other renewable energy technologies. Of course, the financial affordability and the financial return to the purchaser is a most significant factor that will govern the extent of use in developing countries.

During the past 4 years we have been evaluating the ability of photovoltaic technology to meet rural electricity needs in the developing world. We have committed $4.4 million to this since 1979, using as our project manager the NASA-Lewis Research Center in Cleveland, a pioneer in photovoltaic R&D since 1960.

In our initial pilot project we installed a 1.8 kw photovoltaic unit to power a water pump and small grain mill in an Upper Volta village. Equipment procurement and assembly involved a number of U.S. suppliers, many of which were small business firms. The basic PV modules were bought from Solarex Corp. of Rockville, Md., and Sensor Technology, Inc., both of which were then small enterprises. Suppliers of other components and load devices, as well as the firm that assembled the panels and control box, were also small enterprises.

NASA's field tests enabled the manufacturers to modify system components and significantly improve their reliability. We believe that with increased volume, mechanization, and further technological advances expected to result in lower prices, photovoltaics should be increasingly competitive in remote locations as costs for electricity generated from fossil fuels continue to rise.

We have a project in Tunisia, we soon expect to operate a photovoltaic power system integrated with wind and solar heating units. In this project, cost-shared with the Government of Tunisia, the Solar Power Corp. of Woburn, Mass., is installing a 10 to 20 kw system to meet domestic and commercial needs in the village. At another remote Tunisian site, two 600-watt systems will power drip irrigation in a greenhouse and orchard. About one-quarter of the procurement in this $880,000 experimental program has been from U.S. small business. As a matter of fact, some of the project is being cost-shared by the prime and small business subcontractors themselves and this certainly indicates the private sector interest in this area of activity. As photovoltaic costs drop, U.S. manufacturers, through such demonstrations, should be effectively positioned to take advantage of the market potential in rural areas of the Third World.

As has already been mentioned, at a number of remote sites in developing countries, AID is supporting, together with the Department of Energy and the Department of Health and Human Services, field tests of photovoltaic-powered refrigerators for the preservation of vaccines. Refrigeration of pharmaceuticals is difficult in rural locations where electricity, when available, often is unreliable. Photovoltaics, together with the appropriate energy storage system, offer a more reliable energy supply than conventional systems, thus helping to assure the effectiveness of the vaccines.

To evaluate the refrigerators, the Lewis Center purchased under bid ten units from Solar Power Corp. and negotiation for purchase of ten from Solavolt International, are underway. Of the procurement 11 percent for the Solar Power contract was from small business, and 35 percent of the Solavolt contract is expected to be from small business.

AID has funded photovoltaic-powered electricity supplies for five rural health clinics in Ecuador, Guyana, Kenya, and Zimbabwe. Each clinic will apply its 4,000 watt-hours per day of electrical energy for refrigeration of vaccines, ionization sterilization, lights for examination, treatment, and surgery, dental drills and other medical equipment. These health clinics are well-suited to photovoltaic power since they require modest amounts of electricity from a reliable source. U.S. manufacturers supplying the equipment foresee a sizable market for applications in developing countries. All procurement for the five village health clinics was awarded to U.S. small business. As a result of the initial field tests, the Inter-American Bank asked Solarex for price quotes on the replication of these systems in Ecuador and Guyana. Furthermore, the Solar Power Corp. has sold a number of PV-powered medical refrigerators to several private donor organizations and plans to tap the global market for high-quality medical refrigerators, which it estimates will be 60,000 units within this decade. As the cost of photovoltaics declines, this source of power conceivably could become the least expensive and most reliable for selected decentralized applications in developing countries.

Other AID projects have investigated applications of photovoltaic power. In Botswana, we have purchased medical refrigerators and we are looking at photovoltaics for water pumps to provide the power for them. Photovoltaics for pumping water and providing electric power for other rural needs are among a number of renewable energy technologies being tested in the hope that widespread adoption of technologies which are successful will reduce Botswana's dependence upon imported oil.

In Mali we are also field testing photovoltaic-powered pumps, refrigerators, and lighting as part of a 5-year, $4 million project. ARCO Solar and Solarex are supplying the solar arrays, and it is expected that U.S. small business will help provide other components of the systems.

Our mission in Niger is procuring a pump from Solar Electric International of Maryland, a small firm, to function with a photovoltaic array from Solarex. The University of Dar es Salaam in Tanzania is negotiating with Solarex and Solar Electric Systems of Coronado, Calif., a small business, to supply a photovoltaic system for lighting and refrigeration in a rural village dispensary. This is an experimental project designed to provide university faculty with data and experience for future applications of solar power.

Turning to Asia, META Systems, a small energy consulting firm in Cambridge, Mass., has just completed a study for AID and the Philippine Government on the economic and social factors which affect public and private sector investment decisions for village potable water systems powered by solar electric cells. Small-scale suppliers from the U.S. and the Philippines could be involved in any follow-on projects.

In Nepal, we have used photovoltaics to power radios in rural areas. The project was discontinued because the photovoltaics panels proved too fragile for the rough handling by mountain folk. In India, the Jet Propulsion Laboratory is using a photovoltaic array in a village project for AID.

Photovoltaics, in combination with diesel generators, are expected to provide energy for ground stations receiving satellite communications. These stations will enable villagers in remote areas to receive educational instruction and medical diagnostics generally unavailable or difficult to obtain by more traditional means. NASA, on behalf of AID, will be issuing a request for proposals in the early part of December for the design and development of this hybrid power supply system. A list of small firms is being drawn up to receive the RFP.

In Haiti, Volunteers in Technical Assistance (VITA) is working with the AID mission on a photovoltaic powered water pump to serve a small fishing community on the northwest coast, Solar West Electric, a small U.S. business, is the supplier. The Agency for International Development is providing support to VITA to provide technical assistance and information to developing countries for rural energy projects. This private, nonprofit organization is promoting collaboration between U.S. industry, mostly small business, and entrepreneurs and users in developing countries. VITA's efforts include providing information on U.S. industry products and services (including company brochures and product specifications, lists of suppliers for specific devices, names of U.S. business distributors abroad, etc.) to business firms and project managers in the Third World. VITA has arranged for the use in developing countries of woodstoves, photovoltaics, and windmills produced by U.S. small business firms.

Through AID training programs such as those in renewable energy at the University of Florida and energy management at Stony Brook in New York, senior and midcareer energy officials from over 40 developing countries have met with U.S. industrial firms, including a photovoltaics manufacturer, for briefings on state-of-the-art, its applications overseas and mechanisms for transferring the technology via the private sector.

SMALL HYDROPOWER AND OTHER RENEWABLE ENERGY ACTIVITIES

AID's development assistance program in small hydropower is exploring the cost-effective production of electricity on a decentralized basis. Our activities have provided excellent opportunities to further marketing interests of the U.S. renewable energy industry. The National Rural Electric Cooperative Association (NRECA), with AID funding, arranges for U.S. experts to conduct resource surveys and small hydropower site feasibility studies in developing countries. The frequent use of experts from U.S. industry and consulting firms in these studies provides our private sector with exposure and access to potential markets. Orders for U.S. turbines, generators and control equipment are resulting from these AID-funded activities. To cite a recent example, NRECA helped the AID mission in Thailand to develop an $8 million project involving procurement of U.S. hydropower equipment for 12 demonstration sites.

Last summer, NRECA conducted a tour of U.S. manufacturers for Panamanian engineers who were selecting equipment for small hydropower plants. Early next year a similar U.S. tour is being arranged by NRECA for hydroelectric engineers from Ecuador. Such efforts should result in orders for U.S. equipment and technical services.

Last July AID brought together 21 representatives of U.S. manufacturers, engineering consultant firms and private developers of small hydrosystems in a 2-day Washington workshop, organized for us by NRECA, to consider ways in which AID and U.S. industry could work together more effectively and enhance U.S. private sector opportunities in the Third World. With only two exceptions, participants represented small business.

In exploring opportunities to increase renewable energy use in the developing world, an integral part of AID's program is to foster the development of indigenous private enterprise. We thus encourage U.S. industry to develop joint ventures and other business arrangements that will result in jobs and other income producing activities in the host countries.

As a result of the workshop recommendations, we are now considering means to: increase the use of U.S. industry experts in LDC hydropower surveys and feasibility studies; facilitate joint venture opportunities, especially in fabricating equipment and providing small-hydropower design and engineering services; provide better information to LDC users on U.S. small hydropower equipment; increase visits of LDC engineers to U.S. industrial facilities, and increase the flow of information about the results of AID-sponsored studies to U.S. industry.

Further interactions between AID and other components of the U.S. renewable energy industry are being explored. We have in mind sponsoring meetings similar to the small hydropower workshop to discuss our programs with representatives of U.S. renewable energy firms. These meetings would develop approaches that meet AID development focus while, at the same time, increase our industry's familiarity with renewable energy opportunities in the LDC's. We are also in close contact with the International Trade Administration in the Department of Commerce, to help assure that their export promotion activities take full account of AID's experience and knowledge of the LDC environment, as well as our program interests and projects.

Bioenergy—the conversion of biomass to useful energy—is a rapidly expanding field that offers small U.S. firms opportunities for marketing products and services in the developing countries. In the Philippines, for example, significant activities are underway for conversion of wood to energy. Within a year, a U.S. manufacturer will receive a contract to supply three 5-megawatt wood-fired boilers with electric generators. The market in the Philippines could exceed 100 such units within 8 years—a market of about $400 million. The Philippine activities also involve the purchase of charcoal-burning gasifiers and kilns for charcoal production. AID expects to finance procurement of over one thousand such gasifiers from U.S. manufacturers within the next 3 years at an estimated total cost of $2.65 million. Similar projects designed to tap indigenous supplies of wood are under development with AID assistance in Indonesia, India, the Dominican Republic and Haiti, among others. All of these provide significant opportunities for U.S. small business.

At last year's U.N. Conference on New and Renewable Sources of Energy the United States proposed that a major share of financing for energy investment in developing countries must come from the private sector. With this in mind, AID joined the World Bank, the United Nations Development Program and other U.N. organizations in sponsoring workshops in New York, Rome, Manila, Kingston, and Nairobi to stimulate new initiatives in renewable energy development by the U.S. and Third World private sectors. These workshops, organized by the International Institute for Environment and Development, are arousing considerable interest among U.S. industry representatives, bankers and donor agencies. The October 19-20 workshop in New York, attended by 25 companies, provided insights into the opportunities for Third World marketing of renewable energy products and services as well as the difficulties encountered.

AID provided funding for two regional development technology exhibitions, in Mexico City and in Zimbabwe. In theory, such exhibitions provide a good means to share technology, encourage development of new trading arrangements, and stimulate the private sector in developing countries. These exhibitions were an experiment for AID. Further involvement in such innovative expositions, perhaps in cooperation with the Department of Commerce, will await the outcome of our more detailed evaluation of the two exhibitions.

In summary, through its technical assistance programs in energy which are directed to addressing the development needs of the LDC's, AID supports U.S. private sector interests and actively includes those of the small business community. This is done in a broad and diverse number of ways:

1. Direct involvement of U.S. industry in AID development assistance. This makes use of U.S. industrial know-how to help the LDC's solve their energy problems, and provides our industry with opportunities to become familiar with developing country markets. Hardware and technical consultants for AID-funded projects are procured from U.S. suppliers. Small business firms have often received contracts, especially in renewable energy activities.
2. Workshops and conferences funded by AID provide new contacts between U.S. industry and developing country energy personnel.
3. AID projects test U.S. energy products in developing countries to obtain information on how they can most effectively satisfy Third World requirements.
4. Developing country markets for renewable energy technologies are identified in the course of the Agency's technical assistance programs. This information is provided to U.S. industry.
5. AID training programs in renewable energy technologies establish contacts between the LDC participants, who are often key Government agency officials, and U.S. industrial representatives.
6. Directories, catalogs, and specifications of American-made equipment are circulated to developing countries by AID and its contractors.

Renewable energy technologies, including photovoltaics, will play an increasing role in developing countries, over time. Small businesses constitute a significant fraction of the renewable energy industry. AID's activities offer encouragement and support to our industry in gaining access to the developing country's market.

Mr. BEDELL. Mr. Earnshaw.

TESTIMONY OF DONALD V. EARNSHAW, DEPUTY ASSISTANT SECRETARY FOR EXPORT DEVELOPMENT, INTERNATIONAL TRADE AGENCY, DEPARTMENT OF COMMERCE

Mr. EARNSHAW. Yes, Mr. Chairman.

First of all, I would like to tell you that I returned this morning from a trade mission led by Secretary Baldridge to Algeria and to Saudi Arabia. I bring to you today an Algerian cold which I cleverly smuggled through customs last night.

We have submitted a lengthy piece of testimony.

Mr. BEDELL. Would you be interested in trading for an American cold that I have had for the last 6 weeks?

Mr. EARNSHAW. In any case, we submitted a paper to the committee. I have some prepared remarks for this afternoon which we have also submitted and in the interest of time, my voice and your patience, I would like to just characterize where I see our relationship with the industry, and what we are doing.

First of all, we are managing trade promotion events both here and abroad that are tailored specifically for and put together in cooperation with the industry. These events by and large are used by the small and medium producers in this industry.

I think it is important to mention that we also have a foreign buyer program where instead of taking the events overseas, we bring the foreign buyer to the events put on by the industry in the United States.

In my view, the relationship between the Department of Commerce and this industry is excellent. I am sitting on top of a lot of relations with lots of industries and there are none better than the relationship we have with this one, where we know what they want, and they know what we can do, and we put it together to their benefit.

I would also like to say that while this Government is huge, we are doing a decent job of communicating between Commerce and AID on the one hand, and Energy on the other. In fact, we have an understanding with Energy whereby they fund through us the participation of part of the members of the industry overseas. I think it is important to say that we had a meeting with AID in my office, I guess it was the day before I went off on this mission. We did compare notes on what each other was doing in an effort to be sure that our efforts were coordinated.

Finally, although it isn't part of the subject here, I think it is important to say that the Export Trading Company legislation, Mr. Chairman, which was signed by the President on October 8, has in my opinion, a very, very significant potential for this industry. It has a potential for any industry that is made up of a number of small- and medium-sized companies which are competitive with one another and which individually don't have the resources to move their products abroad.

Through the use of the Export Trading Company—I know the industry is looking at it—they as competitors can combine forces with antitrust protection and market their products together overseas.

How it is used by this industry and others remains to be seen. I am convinced that it may be one of the most important actions of this administration in the promotion of exports overseas.

I would be happy now to answer your questions.

[For additional material submitted by Mr. Earnshaw, see appendix E.]

[Mr. Earnshaw's prepared statement follows:]

PREPARED STATEMENT OF DONALD V. EARNSHAW, DEPUTY ASSISTANT SECRETARY FOR EXPORT DEVELOPMENT, DEPARTMENT OF COMMERCE

Mr. Chairman and Members of the House Subcommittee on Energy, Environment, and Safety Issues Affecting Small Business, I am Donald V. Earnshaw, Deputy Assistant Secretary for Export Development in the U.S. Department of Commerce. I am pleased to represent the International Trade Administration to speak to you about the promotion of U.S. Renewable Energy technologies, including solar photovoltaics, in International Markets.

Today, I will describe the positive steps that the International Trade Administration is taking to cooperate with the renewable energy industry associations to help this industry take advantage of international market opportunities. I would like to begin my presentation with a brief overview of the responsibilities and organization of the International Trade Administration.

ITA RESPONSIBILITIES AND ORGANIZATION

The primary objective of the International Trade Administration is to promote an improved trade position for U.S. industry in a manner consistent with national security and foreign and economic policies. The Under Secretary of Commerce for International Trade is responsible for carrying out this objective. Responsibilities within the International Trade Administration for the gathering of international economic and commercial intelligence, development of trade policy options, and the management of trade promotion activities are lodged respectively with the Director General of the U.S. and Foreign Commercial Services, and the Assistant Secretaries for International Economic Policy and Trade Development.

U.S. AND FOREIGN COMMERCIAL SERVICES

The 47 district offices of the U.S. Commercial Service have been merged with the 120 overseas posts of the U.S. Foreign Commercial Service to constitute the U.S. and Foreign Commercial Services. The U.S. and Foreign Commercial Services are the front-line source in the United States and abroad for U.S. businessmen seeking to explore the benefits of exporting and investing overseas.

INTERNATIONAL ECONOMIC POLICY

Organized geographically by country and regional offices, International Economic Policy employs the services of a highly qualified professional staff of economists, trade specialists, and policy analysts who maintain in-depth knowledge of current economic and policy developments in their assigned countries.

This knowledge is complemented by the expertise of the Foreign Commercial Service Officers through frequent post reports on country economic and commercial activities. Extracts from these reports are available to U.S. firms in published form as Market Summaries, Overseas Business Reports, and Foreign Economic Trends.

TRADE DEVELOPMENT

The International Trade Administration's Trade Development organization has the primary responsibility for assisting the U.S. private sector in exporting goods and services through information and promotion programs and activities.

Our export promotion functions are the responsibility of my area of Trade Development, i.e., Export Development. Earlier this year, with the consent of the appropriate Congressional committees, the Commerce Department reorganized Export Development. The reorganization created industry-related offices to serve the export requirements of the Capital Goods, Consumer Goods, and Service Industries, as well as an office to manage and support trade events. Staff members in the industry-related offices are assigned responsibility for specific industries.

The importance of this reorganization to U.S. renewable energy firms is the assignment of industry specialists within the Office of Capital Goods Industries to the Alternate Energy Sector. These industry specialists work with the renewable energy trade association representatives and individual firms to effectively assist in developing industry and, in particular, small business.

ITA recognizes the crucial role which can be played by new-to-export and new-to-market firms in expanding the volume of U.S. exports. Frequently, these firms are small businesses which may be interested in overseas markets, but which lack the information or know-how to carry out export transactions. As a result, I directed our industry specialists to compile listings of firms in their assigned industries from various data sources, focusing on new-to-export, new-to-market firms. The objective of this exercise is to increase the awareness by small businesses of ITA's export promotion and informational service activities. I am pleased to inform you, Mr. Chairman, that our efforts have been most successful in the renewable energy area. We have compiled a data base of almost 3,000 solar, wind, biomass, small hydropower and other renewable energy firms, with the vast majority being small businesses. The data base, organized by state, will provide an excellent potential audience for localized seminars promoting export trading companies, planned by ITA's Commercial Service District Offices.

EXPORT PROMOTION FRAMEWORK

The basic framework used by the International Trade Administration in carrying out its export promotion responsibilities with industry is a comprehensive, multiyear Export Development Plan. Developed through consultation with industry trade associations and trade groups, the Export Development Plan represents a joint industry/U.S. Government cooperative approach to increase private sector activity in foreign markets. The Plan contains an economic/international trade profile of the industry, an export promotion and awareness strategy developed by industry representatives, and a Plan of Action based on those strategy elements acceptable to both industry and the Commerce Department. The Export Development Plan provides a model for industry/government cooperation in export promotion, and serves as a guide to the International Trade Administration on industry's foreign market interests and export promotion needs.

In November 1981, ITA completed an Export Development Plan for the Renewable Energy industries. The Executive Summary of this Export Development Plan has been distributed to the Subcommittee members (Attachment 1). The Plan focuses on the the three most commercially viable industry sectors: Solar Thermal, Photovoltaics, and Wind Energy.

In February 1982, the Export Development Plan was distributed to 141 Foreign Service and Foreign Commercial Service posts worldwide and to 48 U.S. Commercial Service district offices nationwide to increase their awareness of the renewable energy industry, its technology, market interests, and export capabilities.

Structured by fiscal year quarter, the renewable energy Export Development Plan lists specific events and activities recommended by the industry to increase the visibility and accessibility of export markets to individual, and in most cases, small firms. The Export Development Plan will be updated during the early months of 1983 to reflect changes over the previous year, as well as revised recommendations from industry.

INDUSTRY RELATIONS

A major objective of export development activities is to encourage and support private sector initiatives designed to increase exports of U.S. goods and services. In carrying out this objective, we have encouraged the formation of trade association international trade committees and multi-trade group export councils.

During the fall 1981 consultations leading to the joint industry/government renewable energy Export Development Plan, industry representatives gave a high priority to the formation of an export council in the Plan strategy.

In March 1982, eight trade associations and trade groups, representing the commercially viable renewable energy industry segments, formed the Export Council for Renewable Energy (ECRE). The Council serves as a focal point for the promotion and expansion of the industry's international trade activities, with an emphasis on the industry's many small businesses. The Commerce Department welcomes the establishment of this independent industry body, and offers its cooperation, whenever possible, in implementing the Council's export promotion and export awareness objectives.

To supplement our efforts with the Export Council and individual trade associations, we are working closely with the trade publications serving the renewable energy sector. This provides an additional marketing tool for reaching those small, new-to-export and new-to-market firms. Announcements and articles regarding the International Trade Administration's export promotion activities have been and will continue to be published in these trade journals and newsletters. This action encourages U.S. firms to contact the Commerce Department for further information.

INTERNATIONAL TRADE ADMINISTRATION'S PROGRAMS AND ACTIVITIES

The International Trade Administration has some 40 programs and services designed to assist individual U.S. firms by increasing their awareness of foreign market opportunities. Although too numerous to detail, Mr. Chairman, a representative listing of these export programs and services has been provided to the members and staff of the assembled subcommittees (Attachment 2).

I would like to focus today on those ITA programs and activities which have proven particularly successful in supporting small business efforts to develop markets overseas and, in particular, promoting U.S. renewable energy exports. These programs and activities include:

1. The Certification Program
2. Domestic Export Awareness Seminars
3. Commercial News USA
4. Exhibitions and Trade Missions.

The Department of Commerce Certification Program promotes a number of major domestic and overseas trade shows to potential foreign buyers through the efforts of the Foreign Commercial Service in diplomatic posts around the world.

This program was very successful in encouraging a relatively large number of business and public sector representatives from developed and developing countries to attend the Solar Technologies Conference and International Exposition, held June 1-5, 1982 in Houston, Texas. Most of the exhibiting firms were small businesses, and a significant number were firms with photovoltaic products or systems.

In publicizing the show, Foreign Commercial Service officers concentrated their promotional efforts on energy end-users, energy planners and marketing representatives of renewable energy and allied fields. ITA's renewable energy industry specialists coordinated the Foreign Commercial Service post promotional efforts with the trade show sponsor and organizer, on behalf of the U.S. exhibiting firms. An International Visitors Center, operated by ITA's industry specialists, offered interpreter and other assistance to all foreign visitors. A directory of those exhibitors interested in export markets, listing product description and type of export interest, was distributed to all foreign visitors. Copies of this directory have been sent to all U.S. diplomatic posts for reference and distribution.

The Commerce Department has certified several domestic trade shows focusing on renewable energy which are scheduled to be held in 1983. Among these are the Renewable Energy Technologies Symposium and International Exposition in Anaheim, California and the Tenth Annual Energy Technologies Conference and Exposition in Washington, D.C. Both shows will offer small businesses the opportunity of exhibiting their technologies to a large foreign audience. In addition, a joint Department of State/Department of Commerce effort has begun to identify ministerial and subministerial level energy officials from selected developing countries for special invitations to attend the Anaheim show. This will further increase the exposure of small businesses and state-of-the-art photovoltaic technology to decisionmakers in major overseas renewable energy markets.

DOMESTIC EXPORT AWARENESS ACTIVITIES

To develop awareness of the market opportunities for exports, ITA sponsors and organizes export awareness seminars. These are designed to inform U.S. firms of the necessary steps which must be taken in order to export their products. Firms which attend these seminars are provided with follow-up, individualized business counseling by the district office closest to them. In 1980 and 1981, six semiars were held for the solar energy industry, attracting about 250 firms. Over 80 percent of those firms in attendance were small businesses. Further seminars for solar, wind and solid fuel heating firms are being planned for fiscal year 1984.

COMMERCIAL NEWS USA

The International Trade Administration publishes and distributes overseas a monthly magazine which promotes U.S. products and equipment. This publication is especially useful for small firms wishing to generate overseas sales leads without incurring significant expenses. ITA published an exclusive issue of Commercial News USA in fiscal year 1981 on the U.S. renewable energy industry. The magazine contained articles on the state-of-the-art technology in all renewable energy fields, as well as individual U.S. company advertisements. This publication was distributed to over 240 U.S. diplomatic posts, translated into the language of the foreign country, and redistributed to the local business community. Through Commercial New USA, a U.S. company has the potential to reach over 250,000 foreign business executives and government officials for a cost of only $40 percent advertisement. The success of this issue had led us to schedule another exclusive issue for the renewable energy sector in December 1983.

EXHIBITIONS AND TRADE MISSION

Mr. Chairman, one of the most effective methods of promoting U.S. goods and services in foreign markets is through Commerce-organized trade exhibitions and missions.

Exhibitions include country and industry trade fairs, solo fairs, catalog shows and video catalog shows. Trade missions include officially sponsored seminar missions and specialized trade missions, as well as industry-organized, government-approved trade missions.

The International Trade Administration recognizes the importance of exhibitions and missions to medium-to-high technology firms, including those in the renewable energy sector. Based on the successful trade events organized by the Department of Commerce and funded by the Department of Energy in fiscal year 1981, ITA has recently agreed to an industry-initiated joint government/private sector approach to export development of renewable energy technologies. Following efforts by the Export Council for Renewable Energy, Department of Energy funds have been set aside for use in encouraging participation by U.S. firms in selected overseas trade events recommended by the Export Council and sponsored by the International Trade Administration. The total costs of exhibiting in a Commerce Department pavilion or participating in a trade mission or other overseas trade promotion activity will be equally shared through contributions by the U.S. renewable energy firms and use of the DOE funds. The objective of this approach is to increase the exposure of small, new-to-export, new-to-market renewable energy firms, with limited resources, to overseas market opportunities. Announcements of this approach and a schedule of ITA's trade events involving renewable energy will be sent to all of the renewable energy firms in our data base, and will be published in the major renewable energy publications.

The fiscal year 1983 trade events encompassed by this approach include a Solar and Alternate Energy Seminar trade mission to the Philippines, Thailand and Indonesia; U.S. pavilions featuring renewable energy firms in major energy trade fairs in Hamburg, West Germany and Singapore; a catalog/video catalog display at the Cyprus Fair; and electric power trade missions to the Middle East, Africa, Latin America and Asia suitable for photovoltaic and other renewable energy firms.

Mr. Chairman, as the television newscasters are fond at saying on election night, the initial returns are in and they indicate a very definite trend. The Solar and Alternate Energy Seminar Mission to Southeast Asia, which I mentioned, was completed within the last two weeks. The mission was composed of seven firms, six of which were small businesses, representing photovoltaic, medium temperature solar heating, wind and biogasification energy technologies. The results of the mission are worth noting as barometers for the commercial interest in renewable energy in the region. The Manila and Bangkok seminars attracted overflow audiences. Preliminary projections by four of the seven firms indicate direct sales of almost $2 million in Manila alone. Two additional firms began or completed multi-million dollars joint venture/licensing arrangements in each of the three cities. Five of the firms completed representational arrangements to promote additional sales. Although the final dollar value of sales may fluctuate from the preliminary projections, the cost/benefit ratio of the mission will remain impressive. The total costs, including group transportation and travel expenses, of the mission were approximately $35,000 shared equally by the participating firms and the Department of Energy monies.

In response to industry requests, the fiscal year 1984 plan proposes two trade fairs and two trade missions exclusively for renewable energy companies and an additional four trade events for electric energy manufacturers suitable for participation by many companies in the renewable energy sector.

FURTHER ASSISTANCE FOR EXPORT OF RENEWABLE ENERGY TECHNOLOGY

Exports of renewable energy technologies and devices should benefit considerably from the enactment of Export Trading Company (ETC) legislation. This legislation seems almost made-to-order for this industrial sector. The ETC is specifically designed to encourage small- and medium-size companies that do not presently export—a description that I believe characterizes most of the businesses in the renewable energy field—to band together in joint marketing activities along with banks or other large businesses with export know-how and financial resources to help defray risk. Using the ETC vehicle, renewable energy consulting services, systems and components could be "packaged" by an Export Trading Company with participation by a major architectural, consulting or construction firm and/or banks or insurance companies that might assist in financing major projects abroad.

The Commerce Department, through its Commercial Service District Offices located throughout the country, will be cosponsoring a series of informational seminars focusing on the advantages of export trading companies. The first of these seminars will begin January 13 in New York City.

A major feature of our plans for implementation of this legislation is a matchmaking operation in which ITA will put prospective client firms and principals in touch with each other. We intend to use the U.S. and Foreign Commercial Services, trade associations, State development agencies and any other likely source of assistance to see that firms engaged in marketing renewable energy systems receive effective support and encouragement to participate in ETCs.

Our new Office of Service Industries is another key element in the effort to promote exports of renewable energy systems. That unit, charged with assisting consultants, engineers and other service firms to export, will seek to identify firms offering solar and other renewable energy services and help introduce them to suitable foreign markets.

COOPERATIVE APPROACH TO TRADE DEVELOPMENT

Mr. Chairman, ITA's responsibility in fostering an increased U.S. industry presence in overseas markets goes beyond trade promotion events. Trade development requires the dissemination to individual firms of complete, up-to-date information on major overseas markets, including country economic and commercial structures, policies and activities, economic development plans and projects, tariff and non-tariff barriers, business opportunities, and principal government/private sector contacts. Obtaining this information often involves cooperative arrangements with other U.S. government and international agencies.

Similar to our joint efforts in export promotion with the Department of Energy, ITA has established working relationships with a number of agencies involved in international renewable energy development. My office recently commenced discussions with the Agency for International Development on cooperation in private sector renewable energy technology exhibitions in lesser developed countries.

I represented ITA on an Interagency Working Group on Energy Research, Development and Demonstration, headed by the Department of State and including all government agencies sponsoring programs in international energy research, development or demonstration. The inventory of RD&D projects by country produced by the Working Group has been very helpful to our industry specialists in targeting renewable energy export promotion activities.

ITA's Office of International Sector Policy is currently researching subsidized trade by our major trading competitors in semi-conductors, including photovoltaics. This office coordinates its efforts with the Office of the Special Trade Representative.

Our Office of Major Projects, which disseminates information to U.S. firms on proposed economic development projects funded by U.S. or multilateral sources, works effectively with the International Development Cooperation Agency, the Export-Import Bank, and the Office of the U.S. Executive Director in the major multilateral development banks (including the World Bank).

ITA's industry specialists responsible for alternate energy have worked cooperatively with various officials involved with renewable energy in the Departments of State and Energy, the World Bank, the Washington D.C. Office of Energy within AID, and various state business development and international trade promotion offices. Information obtained by our industry specialists have often proved to be very useful to small and medium-sized renewable energy firms which are investigating sales or joint venture/licensing opportunities in certain developing countries.

A brief example of interagency and intra-ITA cooperation illustrates this. Our Office of Major Projects recently received notification from the Foreign Commercial Service that a Pakistani firm was seeking U.S. photovoltaic systems to power water pumps for a World Bank-funded irrigation project in Pakistan. The major projects officer transmitted this information to a sizeable number of photovoltaic developers and producers. In exploring this trade opportunity, one of these firms, a small, new-to-export photovoltaic developer associated with a U.S. photovoltaics manufacturer, discovered that the Pakistani company was interested in a licensing/joint venture arrangement to produce the power cells in-country. An official from the U.S. firm contacted ITA's industry specialist for alternate energy. Through counseling by the industry specialist, representatives of the U.S. firm met with the ITA's country desk officers, a U.S. Foreign Commercial Service staff officer from Pakistan then visiting the U.S., officials at the Export-Import Bank and Overseas Private Investment Corporation, and the renewable energy specialist at the World Bank to obtain information respectively on Pakistani licensing/joint venture regulations, Exim Bank Loan Guaranty Program, OPIC's investment insurance, and World Bank policies concerning renewable energy loans and the particular irrigation project. ITA was later informed by the U.S. firm that a letter of intent had been signed with the Pakistani firm to license the production of photovoltaic cells for utility electric power generation, as well as for irrigation water pumping. The value of the proposed licensing/joint venture agreement, exclusive of royalties but including equipment, construction and services, was estimated at approximately $10 million.

The success of this and similar cooperative efforts have reaffirmed ITA's commitment to a joint government agency approach to U.S. trade development. The Commerce Department would welcome the opportunity to join the Department of Energy and the Agency for International Development in technical trade promotion efforts.

ITA EXPORT PROMOTION EFFORTS FOCUSING ON PHOTOVOLTAICS

During the past several years, ITA has recognized that the export potential for photovoltaics—focused on developing countries—is increasing at a rapid rate. Decreased solar cell costs resulting from new photovoltaic production technologies—some just reaching the commercialization stage—and sufficient production volume to obtain economies of scale, have combined with an expanding number of end-use applications to stimulate the demand for photovoltaic systems and products worldwide. As a result, the value of U.S. exports of photovoltaic cells and systems (excluding licensing/joint venture agreements) increased by 69 percent from 1979 to 1980. Exports represented over half of all photovoltaic sales by U.S. producers in 1980.

ITA's export promotion efforts towards photovoltaics have focused on increasing the exposure of U.S. photovoltaic firms to this rapidly expanding overseas market. ITA's trade events on renewable energy, electric power generation, and various end-use themes have featured U.S. photovoltaic manufacturing and hardware systems firms. Seminar trade missions, in particular, offer photovoltaic firms the opportunity to present their technology and meet with government and private sector end-users. The recently completed seminar mission to Southeast Asia, which I referred to earlier, including two photovoltaic firms (one of which is a manufacturer). Both of these small firms reported success in obtaining both direct sales and joint venture/licensing agreements.

We plan to recruit a significant number of photovoltaic-powered product and photovoltaic systems firms, many of whom are small and new-to-export, to exhibit in U.S. pavilions at the major 1983 European and Asian energy trade fairs, under the joint industry/government cost-sharing approach.

ITA will also continue its efforts to disseminate developing country market and trade policy information to interested photovoltaic firms, and to promote an increased awareness of the methods and vehicles necessary for successful exporting.

Through two different publications, ITA has promoted photovoltaic technology, products and firms worldwide. In fiscal year 1980 and fiscal year 1981, ITA co-sponsored with the Department of Energy annual profiles on the U.S. photovoltaics industry. These publications, which contained descriptions of the technology and listings of available photovoltaic products, systems, end-use applications and appropriate U.S. firms, were sent to all U.S. diplomatic posts and Export Development Offices around the world. The profiles have been successful in assisting U.S. Foreign Commercial Service Officers and potential foreign buyers to identify appropriate end-uses and U.S. producing or marketing firms.

Photovoltaic technology, systems, and products were also highlighted in the April 1981 issue of our Commercial News USA publication that was exclusively devoted to renewable energy. Over 250,000 copies of this issue, containing advertisements from U.S. photovoltaic firms, were distributed around the world. We expect to repeat the success of this issue in generating sales leads with another exclusive renewable energy issue scheduled for December 1983.

ITA does recognize, however, that as the worldwide demand increases for photovoltaic systems and end-use applications, the export market will become more competitive and more technological in approach. Japan, in particular, has been funding research into new, low-cost, third generation photovoltaic technologies, with the objective of near-term international commercialization. In addition, middle income developing countries—concerned with the prospect of continued dependence on foreign sources for energy—are pressing for photovoltaic commercial transactions stressing technology transfer. These transactions, in the form of licensing and/or joint ventures for the in-country construction of photovoltaic production facilities, involve rights to the latest technology, equipment sales, technical training, and consulting services. Due to the high costs involved, the transactions require financing by a consortium of in-country and foreign public and private sector funds, Export-Import Bank guaranteed or direct loans, and multilateral development bank or institution funds.

This approach appears to be gaining momentum during the 1980's and offers opportunities to expand markets for U.S. photovoltaic manufacturers, as well as small businesses producing products or systems powered by photovoltaics. ITA will continue to assist in the development of this private sector-initiated approach, utilizing the trade development framework which I have outlined before the Subcommittee today.

INTERNATIONAL COMPETITION IN PHOTOVOLTAIC EXPORTS

Mr. Chairman, for over two decades, the United States has been the leader in research and development of photovoltaic technology. Born by our desire to use high technology to provide efficient and inexpensive power for space exploration, solar photovoltaics eventually was perceived as a potential means for alternate energy development in areas of the world without an established electric power grid. Investment by the U.S. public and private sector in research, development and demonstration, and efforts by the private sector to realize economies of scale through mass production techniques have contributed to the significant increase in energy efficiency and reduction in cost of photovoltaic modules during the past eight years.

The U.S. private sector, including an increasing number of small firms backed by investment capital, continues to lead the way for the commercialization of photovoltaics through the development of third and fourth generation technologies. These technologies employ automated thin film processes involving forms of silicon and non-silicon semi-conductor substitutes.

Despite our technological edge, however, U.S. firms face stiff competition in international market development of photovoltaics. Our international competitors, primarily Japan, France, Italy, and West Germany, have utilized their extensive marketing networks in place in the developing world to promote their photovoltaic systems. Japanese and French government agencies, in particular, appear to rely on non-competitive means, that is, donation of equipment or grants of financial and/or development assistance, to promote the export of their respective photovoltaic technologies and systems. These techniques and practices will be included in a future Commerce Department survey of international export promotion programs.

ITA's response to this has been to work with the renewable energy industry representatives to develop a comprehensive approach to export development of renewable energy systems and products, including photovoltaics. The major premise of this approach is that a higher profile for U.S. photovoltaic firms in the international marketplace, combined with a greater stress on the technological and economical advantages of U.S. technology, will effectively counter our competitors' efforts to increase their market share of developing country markets.

I have already outlined the concrete steps which ITA has taken under this approach, including cost-sharing in trade event participation and interagency cooperation. ITA will continue to work with industry representatives, as well with such government agencies as A.I.D., to encourage overseas market development by photovoltaic firms, with a focus on those developing countries where the use of photovoltaic technology, appropriate equipment or products, and systems applications are most promising.

I would like to thank the Subcommittee, Mr. Chairman, for the opportunity of presenting ITA's programs and activities designed to stimulate overseas sales by small, new-to-export photovoltaic firms.

Mr. BEDELL. Thank you very much, Mr. Earnshaw.

I really appreciate the way you folks have summarized your testimony, especially in view of our time constraints.

Mr. Tribble, as I understand it, the Department of Energy has adopted a policy which says that we are only going to look at long-term research. Could you tell us what that policy statement is?

Mr. TRIBBLE. Yes. Generally, we feel that it is necessary for us to get out of the demonstration and commercialization activities, and concentrate our activities in research. We feel that if we can take steps forward in research and provide this information to the industry, then they will be able to build upon it and their products will be a step ahead of the competition.

Mr. BEDELL. Would you include research for improvements to reduce the cost, for example, improvements that reduce costs toward the point of commercialization?

Mr. TRIBBLE. Yes.

Mr. BEDELL. Of a photovoltaic panel?

Mr. TRIBBLE. Yes.

Mr. BEDELL. You said in your testimony that you were working on various PV techniques and materials. You mentioned specifically amorphous silicon. How do you decide which of those materials you should work on?

Mr. TRIBBLE. This is another part of the program that we have. We are trying to learn more of the theory of photon to electrons, light to electricity to conversion, so that we will be then in a position to select materials. We have found largely through an empirical fashion that amorphous silicon is a good material to work with and actually one of our contractors has recently announced an efficiency on the order of 10 percent conversion for amorphous silicon, which is substantially ahead of schedule. We didn't expect to get to this point this early. We are trying to do those things that examine the theory, examine the terms that we know do work, and move the procedures forward.

Mr. BEDELL. The panels which are being sold today, as I understand it, are not amorphous silicon. Is that correct?

Mr. TRIBBLE. No, I would say they are primarily single crystal and polycrystal silicon.

Mr. BEDELL. So in competing in today's market, at the moment the question becomes who will be able to best compete with single crystal silcon or ribbon on technology, whatever it may be, that seems to be the most advantageous.

Mr. TRIBBLE. That is correct.

Mr. BEDELL. You are not doing anything to help those technologies at this time. Is that correct?

Mr. TRIBBLE. We are getting out of the research in that field because we feel that it has, in fact, been taken over by the private sector.

Mr. BEDELL. You believe then there is plenty of money available for pursuit of research in that area, do you?

Mr. TRIBBLE. When you say plenty of money——

Mr. BEDELL. That is where we are in competition today.

Mr. TRIBBLE. Yes.

Mr. BEDELL. We are presently competing with the Japanese, the French, and others for the world PV market. One of the factors in that competition is whether we keep up with them, or ahead of them technologically.

Mr. TRIBBLE. Yes.

Mr. BEDELL. I guess I may not understand exactly what the Japanese are doing. I know they are doing a lot of work on amorphous silicon. I know the Germans are doing a lot of work on crystalline silicon. If that is where the market is today, and if the other countries are continuing to pursue efforts to try to make their industries more competitive in those areas, and we are not following suit, isn't what Mr. Maycock said correct, that our PV technologies are going to lose out in the marketplace? However, if, on the other hand, we pursue the course you are advocating and only emphasize long-term R&D, then we risk losing our presence in today's PV marketplace. This would force us to spend considerable time and effort to reestablish ourselves when our long-range products are ready for commercialization.

I am not trying to be difficult. I think it is a serious problem we have to ask ourselves. I am interested in your response.

Mr. TRIBBLE. A considerable amount of work is being done by the private sector in single crystal and polycrystal silicon. I just attended a dedication recently of the Solarex plant in Maryland, which is what they term a breeder plant, that is, it runs on photovoltaic energy that is generated onsite. They are, of course, working on the polycrystal form and obviously expect substantial increases in their business.

We have this other problem in doing research on that kind of technology in that a number of the companies may very well be doing research that is proprietary, and we do not want to be competing with them, so we maintain close liaison with them.

Mr. BEDELL. Competing with whom?

Mr. TRIBBLE. With the private sector in doing their research.

Mr. BEDELL. Do you think that it is competing with them to fund research? Is it not true when the Government funds that research, the information that research develops is then available?

Mr. TRIBBLE. Yes. What I am saying is they may well be doing some work on a proprietary basis and if we are doing work that will develop the same product on a basis of making it available to everyone, where do you not feel we are competing with them in that?

Mr. BEDELL. That is where we get into our problem. If we believe that we can't do these things because it might cross horns with somebody else, while foreign countries are working together with the industry to do their research, spending money cooperatively, we, instead, erect barriers to cooperate with our industry. We are letting them take markets away from us. We are letting them take the jobs away from us. As a Congressman, such a policy is just inconceivable. You know there is a possibility that thin films will be the answer. You know there is a possibility that pulling off the silicon will be the answer. Nobody today is sure of the answer. They may work, they may be the answer; they may not. You sure know many of those efforts are being cut back because of the policies of the Department of Energy, do you not?

Mr. TRIBBLE. Let me address——

Mr. BEDELL. If you don't, you should come with me to some of the places I visited.

Mr. TRIBBLE. Let me address that question if I may.

On the research and development portion of our expenditures, it is holding up quite well compared to the total budget. The total budget has declined from $150 million in 1980, down to $74 million in 1982. But on the other hand, the money spent in 1982, on research and development was $50.6 million compared to $41.7 million in 1980. So, while the total activity in photovoltaics and the total budget has been coming down, the part devoted to research and development has been fairly stable. It has, in the President's request for 1983, been substantially cut back to a figure of $27 million or $35 million for research and development, but that is a figure that was generally agreed by the House in their mark, which was just under that for that category.

Mr. BEDELL. Agreed to by the House? The administration brings forth those proposals and the House votes on them. My understanding is that in the President's original budget proposal, the only single thing that the House disagreed with was the proposal to slash funds for solar energy. When the President came into office, the House agreed to everything the President asked for. I believe if the President had asked us to go jump out of a window, half of the Congress would have gone and jumped out of a window.

That is not necessarily true today. I don't think it is fair for you to say it was agreed by the House. The fact is that the President called the tune at least in his first year in office. I think everybody knows that is the case. If you are saying the research money stayed the same when we know it was cut to that extent, then I would like to know where you say the cuts came from in regard to the DOE's support for photovoltaics?

Mr. TRIBBLE. The cut in technology development was the main one of mine.

Mr. BEDELL. Isn't that what I am talking about—technology development? Isn't it technology development when we talk about ribbon-pulling and that sort of thing. Isn't that what you are talking about?

Mr. TRIBBLE. Yes, we during that timeframe, did have a number of industries that spent quite a substantial amount of money on pilot plant proposals for development of ribbon technology.

Mr. BEDELL. No question about that. The question is whether much more would have been spent and whether we would have advanced further and would be more competitive with foreign countries, if funds had not been cut to the extent they were. I can't imagine you questioning that.

Mr. TRIBBLE. I understand one of the industries put forth several million dollars into a pilot plant for this purpose, and had we done somewhat the same, unless we were taking another step forward from a technology standpoint, it would have been a rather useless exercise.

Mr. BEDELL. What company?

Mr. TRIBBLE. I understand Westinghouse did this in their dendritic cell technology.

Mr. BEDELL. I was there, I visited them. I can tell you that the people who are involved in that research were extremely enthusiastic about what they thought they could do with the dendritic web. The probem was that the Government support was going to be cut off. My understanding is that when the Government support was cut off, the board of directors or the top people in Westinghouse decided to drop the project. Did I misunderstand what happened?

Mr. TRIBBLE. But did they drop it on that account?

Mr. BEDELL. Yes. That was what the people that were involved in the project thought. You know, Westinghouse is not exactly a small business.

Mr. TRIBBLE. That is true.

Mr. BEDELL. The fact is that if that technology had been developed, and had moved us to the point of competing with Japan, it certainly would have helped create American jobs. Am I not correct in my impression of what happened to the dendritic web? Am I accurately portraying what happened? Do you understand my frustration?

Mr. TRIBBLE. I sure do.

Mr. BEDELL. We don't want to pick on people and we don't want to constantly have you in here and complain. However, it is terribly frustrating for me to sit here and hear us say that we are going to cut taxes for all big corporations all the way, but at the same time we are going to sit back and go ahead and let Japan, Germany, England, France, and other countries spend a little bit of money working with their industries to help them take these markets away from us. That it is more important for us to cut the taxes of big corporations than it is to work with our own business community to see that we can effectively compete in world markets in future technologies.

That is the problem I have. It seems to me we are just absolutely crazy.

I was involved in an exhibit we had out in California on photovoltaics. I understand that we had contracted for space in this exhibit. I called over to your department—not to you personally—and we had the space all paid for. The Jet Propulsion Laboratory arranged the U.S. exhibit under DOE contract only to have your people tell them they couldn't exhibit our PV technologies.

I can't imagine we would pay for space, especially since we were the host country, and then refuse to even put up an exhibit.

Mr. TRIBBLE. We had received an Executive order to cut back on that kind of expenditure, and it was the judgment of those who made the decision that the particular booth was advertising the laboratory more than it was the product.

Mr. BEDELL. Had they seen the booth?

Mr. TRIBBLE. I think they had seen some information on it.

Mr. BEDELL. But they hadn't seen the booth?

Mr. TRIBBLE. Not to my knowledge; no.

Mr. BEDELL. We were the host country?

Mr. TRIBBLE. I am not familiar with the details of it, but I do remember——

Mr. BEDELL. We were the host country and the other countries from all over the world had exhibits there. We paid for ours and had the exhibit prepared, but we didn't show the exhibit. Nobody at DOE had ever looked at the exhibit. Am I correct?

Mr. TRIBBLE. That is my understanding.

Mr. BEDELL. I thought that was the case.

Mr. Vanderryn, were you here for the other testimony that we have had?

Mr. VANDERRYN. Some of it, Mr. Chairman.

Mr. BEDELL. Were you here when we talked about the AID exhibit in Zimbabwe and the success the witness felt it had been?

Mr. VANDERRYN. Yes.

Mr. BEDELL. Do you share that assessment?

Mr. VANDERRYN. I would like to ask Ms. Otis to speak about the exhibit.

Ms. OTIS. The results of the Zimbabwe Fair appear to be successful. We are currently evaluating them with ATI. We expect that they will come out positive. We don't expect that evaluation to be completed for probably 8 to 12 months.

Mr. BEDELL. Very good. The testimony we had indicated that these fairs have been very successful, in the opinion of the people who testified earlier, particularly for small business, as well as the people of Zimbabwe.

I understand there is a proposal for AID to participate in a similar fair in Manila. I understand you have turned that idea down.

Ms. OTIS. That is not quite true. We have heard that there is going to be an exhibit called "Technology for the People" in

Manila in 1983. AID has not received a proposal on that. Were we to receive one, we would have to assess it at that point in time, depending on how far along the evaluations were on the cost effectiveness, and the developmental impact of the one held in Zimbabwe.

Mr. **Bedell**. I have a memo dated September 21, 1982, to ASIA/TD, Gerrit Argento from PRE/PI, Stanley B. Scheinman, subject, "Manila Trade Fair." It reads,

> I want to make sure that you are aware that PRE/PI does not believe that support of such an activity represents the kind of priority which would justify use of its limited resources. The Zimbabwe expenditure was justified only because of perceived prior commitments.

[See appendix F.]

This would seem to contradict what you just said.

Ms. **Otis**. Not completely. I am familiar with that memorandum. There was a misunderstanding at one point in time by various members of the staff of the Policy and Investment Office of the Bureau of Private Enterprise what a technological exhibition really was, as opposed to a trade fair.

The gentleman who refers to that in that memo conceived of that as a trade fair, which AID generally does not support. Once he knows that it is a technological exhibition and the purpose, we reserve the right to respond to evaluate whether there would be further support, but AID generally supports and encourages programs that encourage the transfer of developmental technology.

Mr. **Bedell**. Did he understand that the Zimbabwe——

Ms. **Otis**. No, he had the full details.

Mr. **Bedell**. He said in the memo that, "the Zimbabwe expenditure is justified only because of perceived prior commitments."

Ms. **Otis**. He understood that there was a fair there. I don't know if he understood that it was a technological exhibition as opposed to a trade fair.

Mr. **Bedell**. Who is Mr. Scheinman?

Ms. **Otis**. He is in the Office of Policy Investment of the Bureau for Private Enterprise.

Mr. **Bedell**. Is he your boss?

Ms. **Otis**. No, sir.

Mr. **Bedell**. So if you wanted to support AID trade fairs, you wouldn't need his approval?

Ms. **Otis**. AID does support the concept of technological exhibitions. No, sir, we would not need his approval.

Mr. **Bedell**. Why are you here?

Ms. **Otis**. I am here in my capacity as director of the Office of Business Relations. We are part of the Bureau of Private Enterprise, as is the Office of Policy and Investment. The Zimbabwe Exhibition was done as an innovative experiment. It was supported with funds from the African Bureau and with funds from the Bureau of Private Enterprise.

Mr. **Bedell**. My question is, Is Mr. Scheinman the man who makes the decision as to whether there are additional fairs? Did he decide that the Manila AID Fair would be funded or is it somebody else that made that decision? Does he have veto power over the decision?

Ms. **Otis**. No, he would not have veto power. If there were another exhibition to be held, it would be funded by various portions of AID. It would not necessarily be from that division.

Mr. **Bedell**. So he would not be one that could necessarily stop that?

Ms. **Otis**. Not necessarily.

Mr. **Bedell**. We had earlier testimony that he didn't know what happened in Zimbabwe. The memo indicates he didn't know what it was all about. It concerns me that somebody who doesn't understand what is happening is going to decide whether we can or can't do something. Are you telling me he can't make that decision?

Ms. **Otis**. Not necessarily. Funding for the Zimbabwe Fair, $150,000 came from the African Bureau and $100,000 from the Bureau of Private Enterprise. It was funded as an experiment and an innovative thing. Should it be decided to go forward, it would depend on what bureau or what mission was backing it. It might be the Near East Bureau; who knows?

Mr. **Bedell**. When would you expect the decision to be made as to whether the fair was a success or not?

Ms. **Otis**. I understand the evaluations will be completed in 8 months, perhaps a little bit longer.

Mr. **Bedell**. How soon do we have to have that knowledge in order to determine whether or not we participate in the Manila fair?

Ms. **Otis**. I don't understand the question.

Mr. **Bedell**. If we need to make a commitment to Manila fair in 6 months and the Zimbabwe fair is not going to be evaluated for 8 months, then we have killed Manila. Doesn't 8 months seem an awful long time to decide whether a fair was a success or not when we already have information from the people that were there that say the U.S. pavilion seemed to be well conceived and well received? AID's Zimbabwe mission evaluation of the activity is that it was worth the effort.

Ms. **Otis**. I would like to explain what our evaluations are based on. It will take that amount of time to see what actual business was consummated at the fair. Direct sales, joint ventures, agency agreements, those are things that are not consummated in a hurry. We would like to see the actual figures for that. We would like to get a determination of how cost effective the exhibition was as opposed to perhaps other ways to foster the transfer of developmental technology.

We would like to assess the intangible benefits of the various educational seminars who were there. We would like to get a thorough review by the mission involved in the country to determine their needs. We want to determine whether it is the most cost effective thing for us to do at that time in that particular area as well as the developmental impact.

Mr. **Bedell**. I don't understand. I am a businessman. If business organizations were to go to an exhibit or a fair and then postpone a decision whether they were going to go to another one until they had done what you are talking about, waiting 8 months to find out how much business they had, evaluate this, that and the other, I am telling you business could never on God's earth ever operate. If you want this committee to do so, we will check with the people that exhibited at Zimbabwe and find out how many orders they wrote and find out how much business they did on the spot. Then you can know whether or not that was in and of itself a very, very successful effort. If it was a very, very successful effort just in itself, then do we have to worry a great deal about how much additional help was given by the educational benefits that resulted?

Ms. OTIS. Our main concern would be if it would fit in with AID's mission, if it had a distinct developmental impact and was cost effective with the other program requirements.

Mr. BEDELL. OK. I think that is legitimate. If it was a great economic success and if your effort was much better than what Commerce does, which everybody testifies it is—I'm sorry you weren't here for that testimony.

Mr. EARNSHAW. I was; I didn't like it, either.

Mr. BEDELL. If that is the case, I don't know how it should be funded, but it seems to me to make sense that we should go forward with more fairs. We worry about our mission, your mission and Congress, and as a Congressman, I am worried about is what it is we do in order to help our people sell their products overseas and be competitive to provide jobs for the American people.

I presume we all agree that these fairs are a legitimate effort. If we are going to be prevented from that because your mission is this and his mission is that, then there is something wrong with the laws we have or the rules we have made. Do you understand the concern I have?

Ms. OTIS. Yes, I do.

Mr. BEDELL. What would you do if you were me as a Congressman and you felt the way I have indicated I felt. I have just heard testimony that strongly indicates these fairs make a lot of sense. What would you do if you were me to try to overcome the bureaucratic nightmare that says we shouldn't do any more fairs because that is not our mission even though the Commerce Department isn't doing these fairs because they can't do them as well as you can?

What would you do if you were me and you had an agency that could do these fairs very well and had in the past, but says that their definition of their mission is something else and that is not what they are supposed to be doing? What would you do?

Ms. OTIS. I am not certain what I would do.

Mr. BEDELL. That is a big help.

Ms. OTIS. I can't comment on being able to change the mandate of the Agency for International Development.

Mr. BEDELL. What is your job?

Ms. OTIS. I am Director of the Office of Business Relations. I am Director of the Office of Small and Disadvantaged Business Utilization reporting directly to the Administrator of AID, and Director of the Office of Business Relations which is part of the Bureau of Private Enterprise, and I report to Elise Dupont.

Mr. BEDELL. So you are supposed to see what we can do to promote business?

Ms. OTIS. Yes; the mandate of the Office of Small and Disadvantaged Business Utilization is specifically to increase and be sure that small business gets its fair share of AID's direct contracts.

That is the mandate by law, the function of that office, and, yes, we are certainly supportive seeking ways to help small business.

Mr. **Bedell**. So you should have the same concern I have.

Ms. **Otis**. Yes, sir.

Mr. **Bedell**. You don't know what to do about it and I don't know what to do about it. I wish I had an answer. I can tell you that from my standpoint, 8 months to decide whether anything is any good is absolutely unacceptable. I don't know what I have to do. I am going to find out what I have to do, because it makes no sense whatsoever for it to take you 8 months to find out whether or not an exhibit you had in Zimbabwe was a success or not. As this subcommittee's chairman, I am going to write letters or call more hearings or do whatever I have to do so that it won't take 8 months or more determining whether that fair was a success.

I don't want to be difficult, but if we are going to operate as a reasonable Government we are not going to spend 8 months waiting around to decide whether that fair was a success in order to decide whether we are going to do another one anywhere else. We are running out of time.

I am really sorry, Mr. Earnshaw, I don't want to leave you out of the questioning.

Mr. **Earnshaw**. I am really feeling hurt, Mr. Chairman.

Mr. **Bedell**. I know how disappointed you must be.

Mr. **Earnshaw**. If you don't have the time, Mr. Chairman——

Mr. **Bedell**. In your written testimony, you talked about a Manila trade fair that you recently participated in.

Mr. **Earnshaw**. It just happened, yes.

Mr. **Bedell**. You said it was very successful?

Mr. **Earnshaw**. It appears to be, yes.

Mr. **Bedell**. How long did it take you to decide that?

Mr. **Earnshaw**. I think the show was over 2 weeks ago.

Mr. **Bedell**. You have decided now that it was successful?

Mr. **Earnshaw**. By the standards that we have, yes.

[See appendix G.]

Mr. **Bedell**. Thank you. You also said,

> Despite our technological edge, U.S. firms face stiff competition in international market development in photovoltaics. Our competitors, primarily Japan, France, Italy, and West Germany, have utilized their extensive marketing network in place in the developing world to promote their photovoltaic systems. Japanese and French Government agencies in particular appear to rely on noncompetitive means, that is donation of equipment or grants of financial and/or financial assistance to promote the export of their respective photovoltaic technologies and systems. These techniques and practices will be included in a future Commerce Department survey of international export promotion programs.

Is that right? What I read you to be saying is that our firms are at somewhat of a disadvantage because of the export promotion expenditures that those other nations are making.

Mr. **Earnshaw**. Yes, you could read it that way. As a businessman, which is what I was until I came here about 18 months ago——

Mr. **Bedell**. Maybe that is partly why you decided in 2 weeks whether the Manila exhibit was a success or not. Go ahead; excuse me.

Mr. **Earnshaw**. You have got to know what your competition is doing in order to do what you are doing as effectively as possible. I did not mean that to say, however, that they are beating our socks off.

Mr. **BEDELL**. I understand. I certainly commend you in looking at what they are doing——

Mr. **EARNSHAW**. You are a businessman, too. You have to know what the competition is doing.

Mr. **BEDELL**. Yes; boy, we sure agree. But when you do find out what your competition is doing, normally you try to take whatever actions you need to in order to continue to be competitive?

Mr. **EARNSHAW**. Which may be not to do exactly what they are doing, but something different.

Mr. **BEDELL**. But usually not to do nothing?

Mr. **EARNSHAW**. That is absolutely correct.

Mr. **BEDELL**. What do you think we ought to do?

Mr. **EARNSHAW**. Right now?

Mr. **BEDELL**. You agreed we shouldn't do nothing.

Mr. **EARNSHAW**. We should do what we are doing right now, which is to promote the export of these systems made by this industry effectively where the market is the best. I think we are doing that through trade missions, trade events, trade promotion.

I mentioned in my off-the-cuff testimony that I really believe that this is going to benefit from the use of the export trading company legislation and group them together so that they can be effective. We do not believe that we should subsidize participation in events overseas.

Mr. **BEDELL**. Even if other countries do?

Mr. **EARNSHAW**. That is correct.

Mr. **BEDELL**. So they will do that and we will not?

Mr. **EARNSHAW**. That has been going on for a long time.

Mr. **BEDELL**. You don't think it has adversely affected our sales?

Mr. **EARNSHAW**. It is not helping, but I think that we are very effectively promoting U.S. products overseas. This industry is not a good example of what I am about to say. Our biggest problem in export activity developing our competitiveness overseas is the motivation of the American business community to the fact of the inexorability of international trade as a way to prosper and grow.

Mr. **BEDELL**. I don't question that but I think that photovoltaics is a difficult industry where the market is primarily in the developing world.

Mr. **EARNSHAW**. Yes.

Mr. **BEDELL**. As one of our witnesses testified, a major reason why the trade development program, that is your program, is inattentive to renewables is probably because of its incredibly low funding level. This refers to renewables. The statement says that,

> The current program funding level for TDP is $5 million. This is contrasted with comparable programs in the European Community which are funded at estimated $40 to $60 million. The comparable Japanese program is estimated to be funded at a level of in excess of $100 million.

Is that accurate?

Mr. **EARNSHAW**. Well, the one thing I was going to say, one of the things that I love about Government numbers, if you don't like them, pick your own. It depends entirely on what the assumptions are that lie behind the numbers. But the direction is correct. Those countries spend a great deal more money than we do on export promotion. But I don't think the numbers are comparable in their entirety. The numbers don't include things that States are doing. It doesn't include things that cities are doing, that private organizations, trade clubs, trade organizations in the communities and in States are doing that are all part of the same fabric. The numbers that we see that the competitive nations really do represent Government expenditures and do represent the whole number. I don't think ours does.

Mr. **BEDELL**. Is Japan doing more or less than we are?

Mr. **EARNSHAW**. A lot more and a lot more for a long time, but it is because the private sector has to export in Japan to live. So far in this country that hasn't been true. It is going to be true.

Mr. **BEDELL**. If you were a businessman, which you have been, who in the past you had a competitor who was doing a better job of selling his products overseas because it was more important for him to sell his products overseas.

Mr. **EARNSHAW**. Or he perceived it that way.

Mr. **BEDELL**. In your opinion, the situation was going to change to where it was more important for you to sell overseas than it had been in the past. Your competitor is smaller than you are. Do you expect him to spend a lot more money trying to promote his products overseas than you will spend trying to promote your products overseas?

Mr. **EARNSHAW**. I don't think I understand the question.

Mr. **BEDELL**. If I understood you correctly, I am not supposed to swear, but that means we are supposed to be down for a vote on the floor of the House.

Mr. **EARNSHAW**. I would like to probe the question, answer the question in writing, if I can.

Mr. **BEDELL**. Let me ask the question. I think it is very important. You have already testified you are a businessman.

Mr. **EARNSHAW**. That is correct.

Mr. **BEDELL**. If I understood you correctly, you feel that export markets are going to be more important to U.S. firms. We are going to recognize the importance of exports to a greater extent in the future than we have in the past.

Mr. **EARNSHAW**. There are two "we's" in that. I think the U.S. Government, and I already recognize it as critical. I do not believe so far the business community has the same feeling, but it is coming.

Mr. **BEDELL**. So we agree on those points. I am trying to get to the corollary in business. If you were a businessman and were twice as big as your competitor and your competitor was selling more of his products in one particular market because he felt it was, right or wrong, more important for him to sell in that market than you felt it was for you to sell there, but your assessment was that in the future it would be increasingly more important for you to compete in that market, would you think it proper to sit quietly while your competitor spent significantly more money trying to build that market than you did to try to build your position in that market?

You are going to think I am quibbling. I can't blame you. Because the position you are in——

Mr. **Earnshaw**. No, I am comfortable with the position I am in. We are talking about Japan, I know. All that money spent in export promotion is not public money. About half of it is. In order for us to be competitive with the Japanese, the Government spending more and more money and spending it ahead of the ability of the private sector to keep up with what we are doing is a waste of money.

I believe that as my company becomes more aggressive overseas as a private sector company, I am going to commit more resources to that marketplace. I kind of walked around it, but I know what you are driving at. But I am not going to say that throwing Government money at it is the whole answer.

Mr. **Bedell**. Nobody is claiming that. I was in Zimbabwe myself a year and a half ago. We went out into the hinterlands to a farm. The man there told us that for pumping the water for irrigation it was a tossup whether he put in a photovoltaic panel or a diesel pump. He chose to bring the diesel fuel all the way from South Africa to his farm where he pumped the water. Prices of photovoltaics have gone down substantially in that year and a half.

He told us if he was going to buy photovoltaics he would buy a French unit because the French Government would help with the financing of it, whereas the U.S. Government would not do so. He is going to buy one from France. France will build the industry, they will end up with the sales volume and the money to pay for further research and, in the end, move forward and take the market away from us.

I think as businessmen we should recognize what our competitors are doing. It seems to me we have a choice, do what we are presently doing to take the market or will we sit here and let our competitors take it? If that is the case, I have no argument with our policies. But if we agree that in the future export markets are going to be increasingly important, then I think somebody in our Government has to take the lead and work together with our domestic industry. A lot of the people here would like to do things differently, but they don't have the money. A lot of small businessmen don't have the money necessary to develop foreign markets.

Mr. **Earnshaw**. That is what we are there for.

Mr. **Bedell**. You are there to do it, but we are spending significantly less money doing it than the Japanese are spending. I am sorry if I have pontificated too much. I am sorry. I have great concern over this.

I have to go vote. I have to tell you I think our policies are just absolutely crazy. It seems to me we recognize the importance of the export markets. It seems to me we recognize that photovoltaics is an industry that is going to grow and very likely will have a significant future. To cut back significantly on our funding levels for research and development, and export market development when other countries are moving forward in these areas makes no sense.

Photovoltaics is technology that originated here in the United States. We are spending less than other countries are as a Government to help our PV industry build foreign markets. When we have a trade fair that is a success, we don't know whether we are going to put on another one because we have to wait 8 months to decide whether it was sufficiently successful.

I don't want to be difficult, but I am a businessman. You are a businessman. You too would be frustrated if you were sitting where I am watching this market being taken away from us because of policies which I think are so wrong.

Mr. Tribble, I believe it is because we are spending tremendous amounts of money on nuclear energy, which is certainly in a commercial stage, and which, at least in my mind, does not at this time show anywhere near the potential for growth and expansion that these new renewable energy sources do, that these other research efforts are so shortchanged.

Things may change. I don't argue that, but at this time our policies are counterproductive. As one person involved in this Government, it is a very, very frustrating situation to me. It would be wrong for me to say that to the press and have you here and not let you know that at least I am one Congressman who thinks that these policies are very, very wrong. I know you people frequently do not have the complete freedom in making these decisions.

I know that very, very well. All I can do is to tell you that if there is anybody you want to talk to about this, that there is a committee in Congress in which the chairman is very unhappy with what is being done. You can certainly come and talk to me.

The committee will be in recess for about 10 minutes. Thank you very much for being here.

[A short recess was taken.]

Mr. BEDELL. The committee will come to order.

Our final panel consists of Elliot Berman, from Solar Energy Industry Associates, Bob Hayden, from Renewable Energy, and Sam Enfield, from the Solar Lobby.

We have got 15 minutes, I guess; 17 minutes, I am sorry. The chairman will try to hold his questions. We would sure appreciate it if each of you would summarize as much as you possibly can.

Mr. Berman.

PANEL CONSISTING OF ELLIOT BERMAN; ROBERT T. HAYDEN; AND SAMUEL E. ENFIELD

TESTIMONY OF ELLIOT BERMAN, CHAIRMAN, SOLAR ENERGY INDUSTRY ASSOCIATION

Mr. BERMAN. Certainly, thank you.

My name is Elliot Berman. I am chairman of Photovoltaics Division of Solar Energy Industries Association. The subcommittee has already received written testimony from me and other companies in the association.

I would like to focus on a couple of points that hopefully will put this thing together.

First, unfortunately, Paul Maycock is gone. He and I are good friends but always disagree, so the point I would like to make is at the present time, U.S. industry is ahead in terms of manufacturing and marketing of photovoltaic modules and I believe we will continue to stay ahead.

However, making that better product isn't enough. You have to be able to sell it. It is in this role where I think it is important that we give support to small business because our current products must be serviced by organizations who understand local conditions and needs and design. They have to be able to design and sell and maintain systems at the local level, and that is what isn't happening. That is why we are losing, our today's product is substantially better than the products made in Japan, France, or Germany. When I say better, I mean equivalent quality at a lower cost. That is true today and I believe that will continue to be true. So simply what I am saying is I think it is very important that the Government support of photovoltaic continue and be expanded because it is that bridge between a manufacturer and the customer that is our problem. That is what I consider our problem.

In the United States, the most important ways to have that continue is a continuation and expansion of tax credits because those tax credits allow us to get to customers earlier.

Also, in the U.S. Department of Defense purchasing on renewable energy, I think there should be small business set-asides.

In order of priority, I think the third thing which is an old problem, but one that I have suffered with is the SBA loans. They would really help small business if they were available to small business in new industries. It is very difficult to get an SBA loan when you are a small business in a new industry. It is very easy if you are going to open a new restaurant or barber shop.

Finally, AID, in foreign trade development and a word of caution on this: It is very difficult for somebody to go to a foreign country unless they really have had some experience, but in those cases, the fact that organizations like AID have field offices with people that understand the country, can be very valuable if we could ever figure out how to use it, which we haven't been able to do yet.

Thank you.

Mr. BEDELL. Thank you very much.

[Mr. Berman's prepared statement and attachment follows:]

PREPARED STATEMENT OF ELLIOT BERMAN, CHAIRMAN, SOLAR ENERGY INDUSTRY ASSOCIATION

Chairman Bedell, members, and guests, good morning. My name is Elliot Berman. I am chairman of the Photovoltaic Division of the Solar Energy Industries Association (SEIA). On behalf of the division and the companies it represents, I want to thank you for this opportunity to have our views considered by this committee.

I shall confine my remarks to an identification of the important role of small business in the photovoltaics business as I see it changing and developing, together with some indications of how the governmnent can facilitate this developing role.

Small business has had and will continue to maintain a vital role in R&D with Government contract support. I have discussed this in detail in testimony before the Science and Technology Subcommittee on Energy Development on March 16, 1982, a copy of which is attached.

A significant opportunity for small business exists in specialty and custom photovoltaic modules.

The end user of photovoltaic modules is not interested in photovoltaics but in an independent electricity supply, often as a part of an electrical appliance, instrument, or device. Thus the user, especially the small-scale user, requires the service of a local, specialized business which may be a supplier of photovoltaic modules per se but must in any case understand the user's needs and the technical, economic, and operational means of addressing the individual problem. For photovoltaics to succeed, a worldwide infrastructure of local, mostly small business specialists must be encouraged to develop.

Most energy businesses receive Government support in some form. It was for this reason that the original solar tax credit legislation was created. These credits make it possible to finance the purchase of photovoltaic generators where they can realistically compete with other energy alternatives. Emphasis on this equalization of support is important and, for small business, vital to the survival of photovoltaics in the domestic market, and to any goal of getting the sun to supply part of America's electrical load.

Many technical field requirements exist in Defense which can best be met by photovoltaic power systems. Development or engineering is usually needed, making such applications a natural for innovative and energetic small businesses. Clear small business set-asides are recommended as for example, part of the Department of Defense Renewable Energy Utilization Act.

Continue and ease restrictions on SBA loans.

I believe small businesses can successfully conduct business in foreign countries only under special circumstances. Action by the Government to ease foreign tariffs and other restrictions will help in these cases as will a continuation of foreign trade missions and seminars.

STATEMENT OF THE PHOTOVOLTAIC DIVISION OF THE SOLAR ENERGY INDUSTRY ASSOCIATION, ELLIOT BERMAN, CHAIRMAN

Chairman Fuqua, members, and guests, good morning. My name is Elliot Berman, I am Chairman of the Photovoltaic Division of the Solar Energy Industries Association (SEIA). On behalf of the Division and companies it represents, I want to thank you for this opportunity to have our views considered by this committee.

First, I wish to tell you that the Photovoltaic Division of SEIA is enjoying continued growth. We now represent 34 members. This corresponds to a parallel growth in the industry itself. Strategies Unlimited of Mountain View, Calif., a respected independent market consulting firm, reports that worldwide sales of photovoltaic product have grown from 1.5 MWp in 1979 to 3.3 MWp in 1980, and 5.2 MWp in 1981 to an estimated 8.9 MWp in 1982. Furthermore, U.S. photovoltaic products are still recognized as representing the highest quality in the world market.

Members of the Association also recognize that you in Congress, as well as the Executive branch, face difficult decisions in these economically troubled times.

The U.S. photovoltaic industry is healthy, growing and vital. But we, too, find these to be difficult times for the development, manufacture, and sale of a new energy product as we face growing competition heavily subsidized, if not sponsored, by foreign governments. (Although total sales are growing, market share held by U.S. manufacturers took its first significant drop in 1981).

U.S. government support for the industry has played an important role in our successful development. At this point, however, we see the need for a change in the type of government support given to our industry. There is a need for a transition from an almost government-directed role to a more traditional supportive one. We would urge that this transition be conducted in a rapid but orderly fashion, in order to protect the interests of truly small businesses in the industry lacking the means to carry out certain functions which have been provided by past government programs.

Today, I will present the views of our division on how that transition might best be accomplished. We seek supportive and stable Federal action in the following areas: Basic research, transitional activities, and market stimulation.

We have examined Administration proposals, as well as several other proposals and counter budgets. But in recognition of this transition, we feel it is most appropriate to focus this testimony on industry interests, rather than presenting industry comments on various Federal proposals.

This is said with all due respect for the efforts which have gone into these budgets and proposals, and with no small appreciation for the interest they represent in the success of our industry. The success of our industry, however, depends primarily on us—with your support and help, of course.

Testifying from this perspective (that is, stating what we think should be done, rather than commenting on government proposals) is new for our Association. Therefore, I feel I should tell you what we have done to gather the information upon which this testimony is based. I, of course, cannot claim that the views I am about to present represent exactly the individual views of our industry. Efforts to elicit opinions of our industry include questionnaires sent by the SEIA staff in February. This mailing included in early form the budget we are proposing. A more detailed questionnaire on research priorities which I sent to the industry on March 3 for their response is appended. Telephone conversations between the industry (both members and nonmembers of SEIA's Photovoltaic Division, including small businesses) and myself and Mr. Tenet of the SEIA staff regarding this testimony during the past month have been extensive.

Even with all the information we gathered, much of what you hear today, and certainly what you will hear in the question-and-answer period, is colored by my own personal experiences and biases, since I was elected chairman and given this opportunity and responsibility to report on the industry. Therefore, if you will bear with me, I will provide a brief summary of my career, which is given in more detail in the biography at the end of my testimony. I have spent over 25 years in U.S. industry in the fields of photochemistry, photophysics and solar energy utilization. In 1969 I founded Solar Power Corporation, the first company devoted exclusively to the manufacture and marketing of terrestrial solar cells. I also served as president of Sun Systems, Inc., a small business which manufactures and markets flat-plate solar water and solar air heating systems, as well as an insolation measuring device. I am presently chief scientist for ARCO Solar, Inc., a subsidiary of Atlantic Richfield Company.

Let me return to the position of the Photovoltaic Division of SEIA. First, let me reiterate that we believe the Federal government has a continuing vital role to play in accelerating the economic use of photovoltaic energy. We believe it is appropriate for the Federal government to play this role, on the basis of the importance this industry will have in our nation's future balance of trade. The industry has great potential impact on national security needs, and can be a factor in the event of disruptions in national energy supply. Thus we believe that successful rapid development to the U.S. photovoltaic industry is important to the nation's future.

Successful development of economic electricity from our sun requires two things: economic solar devices and an industry to produce and market those devices.

CURRENT INDUSTRY NEEDS

Of all the activities of the Federal government which might contribute to the development of the U.S. photovoltaic industry, there is one that is agreed upon as being central to our current and future growth. In our economic system, it is the one governmental action that supports, stimulates and encourages our industry without distorting or possibly stunting its growth. Here, I am referring to the business energy tax credit.

The maintenance and extension of the current 15-percent business energy tax credit is crucial to our continued growth. Its expansion to 30 percent and extension for an additional five years would be the single most economic and effective action that the U.S. government could take. According to our calculations, this credit would cost the Treasury no more than $7 million for each 15 percent of the credit's value during this year. This could reach $35 million during the fifth year.

I understand that this issue is beyond the jurisdiction of this committee; but as the committee that has been most involved with and concerned about this industry, we would hope that you would do everything possible to promote this action.

We would also seek your assistance in another important area that may be beyond the purview of your committee. Since a major portion of our near-term business is and will be conducted overseas, we will continue to require assistance in overcoming foreign trade barriers. In addition to the standard support that is generally provided by the U.S. Department of Commerce on behalf of all U.S. industry, we feel that special attention should be directed to what appears to be a growing protectionist tendency of foreign countries toward U.S. manufacturers of photovoltaic technology.

Now, let us discuss areas in which this committee has direct jurisdiction:

Areas of near-term importance in addition to the tax credit and foreign trade assistance:

Maintenance and monitoring of existing DOE-sponsored photovoltaic demonstration installations: A large number of photovoltaic installations deployed by DOE deserve to be adequately maintained if they are to be an asset to the industry's marketing efforts rather than a liability. Furthermore, information about the performance, maintenance and other key data from these installations can play a very beneficial role for the industry. If this were not done, these installations might turn into an embarrassment to the government as well as U.S. industry, and currently it appears no adequate plans have been made to ensure this is performed.

Standards and Tests: This area, which has been heavily subsidized, if not totally sponsored by, DOE, represents a particular problem for the small business membership of our association. Unless funding is provided for an adequate transition, the cost to test products may be prohibitive. In the area of standards, the leadership position of the United States can be threatened without some continued transition funding over the next several years while the industry grows and organizes itself to take up this very important effort.

Development of a global insolation data base: Employing data from our weather satellites which is currently collected but not available in a useful form, the U.S.

government could assist the industry greatly by inventorying our fuel source on a worldwide basis. There is no adequate information about insolation for many parts of this country as well as great portions of the rest of the world. Assemblying and processing this data from that already collected by our satellites would provide a major boost to the development of our industry here as well as abroad.

Development of a large-scale utility project and the attendant balance of systems efforts: This can have an important beneficial effect for the U.S. photovoltaic industry. The SEIA Photovoltaic Division recognizes the need for a large-scale utility experiment expanding the Sacramento Municipal Utility District (SMUD) project beyond its initial one megawatt. Continuing on with the plan of development in this area will provide a much-needed experience in development, operation and maintenance of a major photovoltaic component for a willing utility partner located on the Pacific rim. The SMUD installation will offer a clear example of this nation's continuing commitment to the development of high technology renewable resources.

Now I would like to consider that area which represents the largest budgetary segment of our proposal: that having to do with the future of the industry, the area of research. It is this area in which I am personally most at home.

To introduce this section of my testimony, I would like to quote from Gulliver's Travels by Jonathan Swift, published in 1726. Gulliver is visiting the Grand Academy of Lagado, a government-funded research institute:

"The first man I saw was of a meagre Aspect, with sooty Hands and Face, his Hair and Beard long, ragged and singed in several Places. His Clothes, Shirt and Skin were all of the same Colour. He had been Eight Years upon a project for extracting Sun-Beams out of Cucumbers, which were to be put into Vials hermetically sealed, and let out to warm the Air in raw inclement Summers. He told me, he did not doubt in Eight Years more, that he should be able to supply the Governor's Gardens with Sunshine at a reasonable Rate; but he complained that his Stock was low, and intreated me to give him something as an Encouragement to Ingenuity, especially since this had been a very dear Season for Cucumbers. I made him a small Present, for my Lord had furnished me with Money on purpose, because he knew their Practice of begging from all who go to see them."

I and many of my research colleagues are well described by Swift. We have been engaged in solar energy research for a long time; we are optimists; we are always halfway there; and we always need more money.

Whatever the case, research on fundamental questions is important to the future development of the U.S. photovoltaic industry. So if you will forgive my "meagre aspect," I would like to present for your consideration our thoughts on not only what should be pursued by government-sponsored research, but just as importantly, how that pursuit can be structured to have the most beneficial impact on the industry.

First, I think it is important to note for the record that we believe our current technology is sound, and provides excellent product with good value for our current customers and their applications, which are primarily for remote sites where our products replace diesel generators.

With that said, however, there is no question that substantial reduction in the cost of solar cell systems is required before these systems can have a major positive effect on our nation's needs. These reductions require the discovery of potentially low-cost materials, a fundamental understanding of potentially low-cost materials, and the development of manufacturing, packaging and deployment technology for these materials.

Discovery (invention) is not the sole province of individuals, large or small business, academia, or government. All contribute. I believe that past government programs in solar energy have suffered by overemphasizing the role of government program managers in the discovery process.

A fundamental understanding of materials and their workings requires high caliber technical people and equipment in a stable environment. Industry, government and academia will contribute together in this area if the national objective is clear.

In our society, the development of manufacturing, packaging and deployment technology is the province of industry.

We believe that U.S. industry efforts would be substantially accelerated if a government Laboratory Center of Excellence existed that was conducting research directed to the discovery of potentially low-cost materials and a fundamental understanding of solar devices. This Institute would be given sufficient funding on a continuing basis to support a high-quality group of scientists with high-quality equipment. It is not possible to properly carry out these long-range activities in an unstable environment with constantly changing goals and directives. A major portion of its activity would be conducted in-house, with the ability to contract some work to universities, small businesses, and other government laboratories. (We do not believe that the government should fund non-small business to conduct research of commercial importance.)

The Institute would have the ability to perform specialized measurements and characterization work for industry. In short, the Institute could function as a focal point to care for current needs such as those already discussed, as well as future requirements.

The Institute must have the ability to accept industry scientists to work in its laboratories for three-month to one-year terms, during which time the knowledge developed would be directly transferred to industry. This interaction would provide not only for information transfer from the Institute to industry, but give direct feedback to the Institute (Government) of industry's needs and goals. This arrangement has the advantages of research conducted in a university setting in terms of independence, stability, and excellence, but it offers a much more timely and practical infusion of knowledge to industry, through its representatives participating in their work.

Those representatives can then return to their companies, having learned the state of the art, and begin their own efforts to build on this knowledge and produce commercially important patentable innovations of their own. These "idyllic" arrangements already exist in Japan and France.

We believe that Federal support should be focused on research activities on thin film and other innovative devices that have the potential of bringing the price of photovoltaic-generated electricity to that at least competitive with other options.

We recommend that this support be implemented through a single government organization with a single focus, i.e., solar energy. We further recommend that industry and academia have a direct hand in its program selection processes. Finally, it is very desirable for the type of institution we have recommended that its stability and independence, in short, its research integrity, be guaranteed by providing for a governance structure composed of a board representing industry, academia and government as well as energy users, which insulates it from the whims and fancies of any transitory political situation.

I believe that the Solar Energy Research Institute is a viable foundation on which to build a Government Laboratory Center of Excellence.

To summarize: The PV division of SEIA has the following requests and recommendations:

(1) The business energy investment tax credit must be maintained, extended and expanded. This will provide the most effective and efficient stimulus to our industry's growth. This help plus attention and aid with foreign trade barriers will maintain the leadership of U.S. companies in the face of strong foreign competition in the near term. We request your help in these areas.

(2) We strongly recommend that you authorize the establishment of a National Laboratory Center of Excellence, insulated from immediate political winds and whims; open to the direct participation of industry representatives and the focal point for current needs (such as the collection of global insolation data, transitional funding of standards and testing work as discussed above) and committed to research activities on thin film and other innovative devices. We estimate funding requirements for current needs as six (6) million dollars and research funding requirements of the order of thirty (30) million dollars a year over the next several years.

(3) We also recommend you proceed with the authorization for stage 2 of SMUD and attendant balance of systems (estimated funding requirements ten (10) million dollars).

Finally, returning to Gulliver's Travels. The Grand Academy of Lagado consisted of a group of well-intentioned government employees doing research without regard to the real world or the cost of cucumbers. We believe our recommendations will create the necessary cooperation between the public and private sectors leading to the rapid, successful development of photovoltaic systems essential to the nation's future.

Mr. **Bedell**. Mr. Hayden?

TESTIMONY OF ROBERT T. HAYDEN, DIRECTOR OF PROGRAM MANAGEMENT, RENEWABLE ENERGY INSTITUTE

Mr. **Hayden**. Thank you, Mr. Chairman.

My name is Robert Hayden. I am director of program management at the Renewable Energy Institute. I, too, have submitted a lengthy statement which I would request be included in the record along with documents that I have referenced in that statement.

Mr. **Bedell**. Without objection.

Mr. **Hayden**. I will very quickly summarize.

We have during the day heard a great deal which establishes the importance of the international marketing activities in the renewable energy area. The need for the growth of international markets for this industry is very apparent. We have heard a great deal on the nature of the international competition we are facing in that industry.

In my testimony, I have listed a number of elements which I feel are particularly key for the renewable energy industry in looking at how to approach international marketing and ways in which the Government has a role to play in supporting those activities.

Most of those elements have been mentioned in some form today. I am certainly not going to repeat them. There is one point, however, I think has not come out and which is extremely pertinent to the jurisdiction of your committee regarding small businesses. That point is the difficulty of small firms participating in the international market.

Marketing in developing countries is certainly not an endeavor to be entered into lightly. It requires a strong commitment of time, effort, and resources. It has high elements of risk and requires the ability to work cooperatively with the host government. This is perhaps particulary true for renewable energy since the technologies are often viewed as unproven. Whether they are or not, the perception exists. Also, the initial capital costs are very high compared to some other types of investments. This is, further compounded now by the acute shortages of capital foreign exchange within the developing countries.

Furthermore, because of the critical energy needs for development in the Third World, the governments tend to pay very close attention and put their hand in energy activities within their country. This can be as much a complicating factor as a benefit for a company wanting to engage in the marketing of energy products in a Third World country.

Finally, there is the issue the technology transfer. Companies which manufacture renewable energy products in the United States and comtemplate of exporting must be well aware of the fact that often they are going to face a situation where the countries don't really want their products. Instead, they want to get rights to the technology, consequently joint venture operations will often be the route that will have to be taken.

All of this puts particular strains, I think, on the capabilities of small companies that are not experienced in international markets. These strains lend particular credence to the point Mr. Earnshaw brought out about the value of export trading companies as a means of bringing together financial institutions and product manufacturers. Through trading companies, manufacturers can obtain greater capability and expertise for entering the international markets.

The root of the problem we are facing, Mr. Chairman, is twofold: First, if we ever did have an energy policy in this country, obviously we do not now. The renewable energy industry is painfully feeling the effects of the absence of a national energy policy. Second, we have no comprehensive trade development strategy in this country. The absence of a comprehensive trade policy particularly hurts the renewable energy industry because of the importance of the international markets for this emerging industry.

Yet it is amazing to say we have no trade strategy, when you look at the range of programs available to companies who are interested in exporting.

You have heard from the Commerce Department, and you have discussed with AID the type of role it can play in helping companies establish an overseas presence. But there is also the Export-Import Bank, the Overseas Private Investment Corporation, the Trade and Development program, and the Small Business Administration. If you add up the types of services available through these programs, it is rather an impressive array.

What we don't have in this country is any mechanism for pulling these varied programs together and allowing them to give a coordinated focus for any particular type of industry. I think it could well be argued that the renewable energy industry could very easily provide a prototype, if you will, for developing a coordinated export trade strategy for the country.

The pieces for a trade strategy are there because many of the types of services needed exist, albeit in disjointed form. The needs are there. This is an industry which is emerging, and which must depend to an important extent on international markets. It is one in which there is great growth potential. Certainly our European and Japanese competitors have recognized that potential and they have established targeting policies to support those industries. It is an industry in which there is great U.S. need for the product. We need to establish it for our own energy needs.

It is an industry in which there is a fantastic need in the developing countries. If we could simply find a way to place within the Government a high level focal point for renewable energy export activities we could then pull together some of these disparate programs and have at least a semblance of a trade policy that would be of immense help to the companies in this industry.

Thank you.

Mr. BEDELL. Thank you very much.

[Mr. Hayden's prepared statement follows:]

PREPARED STATEMENT OF ROBERT T. HAYDEN, DIRECTOR OF PROGRAM MANAGEMENT, RENEWABLE ENERGY INSTITUTE

Mr. Chairman, members of the Subcommittee, thank you for this opportunity to present some of the views of the Renewable Energy Institute on the important subject of marketing opportunities for the photovoltaics industry. I am Robert Hayden, Director of Program Management for the Institute.

The Renewable Energy Institute is a private, nonprofit organization which conducts policy research and education activities on matters affecting all renewable energy technologies. Our board of directors reflects the broad range of the Institute's focus. Represented on the board are large and small renewable energy companies, large electric utilities and rural electric co-ops, the homebuilding industry, financiers, distinguished academicians, and the public interest community.

The diversity of our board is an indication of the diversity of the renewable energy industry itself, and of the complexity of the forces that shape it. Those forces include public policies as well as market forces.

Marketplace activity in renewable energy is growing, even in the recession, showing dramatically that for some of the technologies the future is here and now. Nevertheless, the development and commercialization of photovoltaics, solar thermal, wind, small hydro, biomass, and other renewable energy systems cannot be divorced from public policy considerations. Direct government support for technology development, which as you know has decreased dramatically under the Reagan administration, is only one aspect of public policy consideration. Equally important, and for some technologies more important, is the structure of the U.S. tax code and its impact on renewable energy investments. Another example of the critical importance of public policy in renewable energy commercialization is found in international marketing. Smaller renewable energy companies often need some government support to help them enter the international market, while companies of any size may need government help in overcoming the advantages their competitors from other OECD countries enjoy as a result of their country's industrial targeting practices.

I will address most of my remarks to some of the key elements that will be involved in expanding the international commercial sales of U.S. renewable energy technologies. In addition, I will submit to the committee several documents that are especially pertinent to the crucial role that tax policy plays in the commercialization of renewable energy.

INTERNATIONAL MARKETING

It is widely felt that developing countries offer a vast potential market for renewable energy systems. The oppressive drain that oil imports place on foreign exchange holdings of most developing countries makes indigenous energy production particularly important for them. At the same time, the general lack of extensive electric energy grid systems in developing countries makes the decentralized nature of renewable energy systems attractive both technologically and from a cost standpoint. Indeed, 51 percent of all U.S. photovoltaic sales in 1980 were export sales.

However, there are a number of critical constraints in the ability of renewable energy companies to meet the potentially huge demand for their products in Third World nations. Most obvious of the constraints is the lack of foreign exchange in the developing countries to pay for renewable energy systems, but there are other important constraints as well.

In earlier testimony today by the Export Council for Renewable Energy, the Committee was presented with a thorough description of the nature of foreign competition U.S. renewable energy companies are up against in third-country markets as a result of the export supporting programs of our trading partners. The Renewable Energy Institute is a member of the Export Council, and we fully subscribe to the recommendations made by ECRE for modest but effective government programs to help build overseas sales opportunities for U.S. renewable energy companies.

In looking at the international commercial opportunities for renewable energy, I would like to highlight five key elements. Some of these elements point to approaches and actions that companies themselves must take, and some point to the need for government action.

(1) *Difficulty of small firms attempting international marketing.* Marketing in developing countries is not an endeavor to be entered into lightly. It requires a strong commitment of time, effort and resources, has high elements of risk and frustration, and requires the ability to work cooperatively with the host government. This is particularly true for renewable energy since the technologies are often viewed as unproven, the initial capital costs are high (compounded by acute shortages of foreign exchange in most developing countries), and the critical need for energy for development often leads to close attention from the host government, which can be a complicating factor as well as a benefit.

In addition, exporters of renewable energy products must be prepared for the fact that in many developing countries there is a strong preference for the transfer of technology to enable local production, as opposed to importing products from the U.S. or elsewhere. In many countries, companies will find themselves dealing in an environment where a frequent attitude is: "We don't want your product, we want your technology—and we want you only as a minority equity holder."

To deal with these problems, and to sort out which countries they ought to even think about a realistic market opportunities, the small and medium size companies that characterize much of the renewable energy industry will need a great deal of informational help. Most of these companies have little or no experience in overseas marketing. The Renewable Energy Institute and the Export Council are actively working to develop means in which companies can find this type of information. As part of our efforts, we are working to see to it that the Commerce Department market research programs and other government programs will adequately address the needs of the renewable energy industry.

(2) *Value of export trading companies and other combined efforts.* Because of the complexity and risks involved with international marketing, the best advice in many cases may be to discourage small companies from entering the international market on their own, and encouraging some sort of combined effort. The difficulties encountered by small and medium size renewable energy companies in LDC markets are sometimes likely to be overcome best by newly-authorized trading company organizations or by "piggybacking" on the established overseas infrastructure of a larger company. Through combinations of one sort or another, renewable energy companies might team up with others who can provide financing packages, who have established contacts and entrée in a foreign market, or whose products contribute to a broader, more flexible, and more marketable mix of offerings to appeal to developing countries for meeting their energy needs.

(3) *Lack of knowledge by companies on how best to take advantage of government services and programs that are available.* There is a surprisingly large number of government programs in existence that have the potential for offering renewable energy companies help in one form or another in overseas marketing. Few renewable energy companies, however, are in a position to spend the time necessary to identify and tap these scattered services.

The Commerce Department offers a wide range of programs, including market research, foreign buyer identification, and overseas trade missions. AID provides opportunities for overseas sales through project-related procurement, and potentially also through channels being established in the Office for Private Enterprise. Other government agencies that do or could have applicable programs include the Export-Import Bank, Trade and Development Program, Overseas Private Investment Corporation, and the Small Business Administration. As discussed in No. 4 below, there is no central coordinating point among these programs. Therefore, the small business exporter is unlikely to be able to take the time to explore fully the opportunities.

Not only should an exporter know of the range of programs offered by these agencies, but to use them effectively he should also be sensitive to the different missions of the various government programs. Some agencies, for instance, are oriented towards host-country economic development (AID, TDP, OPIC), while others are more exclusively export-supporting in nature. In order to take full advantage of the programs, the exporter must be able to recognize where there is a merging of his interests and those of a particular agency or among a combination of agencies. Because of the difficulty in doing this, many potential support activities are not being used as they could be.

(4) *Failure of government programs to pay adequate attention to renewable energy exports, and lack of coordination among programs.* While there are numerous government programs from which companies can get some export help, few if any of the programs are doing nearly as much for renewable energy as they could. Among export-promoting agencies, none has a conscious focus on renewables except for the Office in the International Trade Administration (Dept. of Commerce) handling overseas trade events.

The EximBank has effectively precluded renewable energy projects from eligibility for its Direct Loan Program (i.e, low interest lending) by virtue of the $5 million minimum it has established as a criterion for project size. Most overseas renewable energy sales do not fall within that scale. There have been proposals for a small business setaside with Exim. This would help bring renewables into the purview of the Bank's lending program. However, a small business setaside by itself would not help with projects by the larger renewable energy companies in their competition with foreign manufacturers who do receive export credit financing. Therefore, in addition to a small business setaside, the dollar threshold for project eligibility should be decreased.

Among Third World development agencies, AID has had a focus on renewables, but the Trade and Development Programs and OPIC have not. Within AID, however, there has been little effort to recognize and maximize the benefit U.S. exporting companies can obtain from the agency's development programs. The U.S. has deliberately shunned a linkage between trade and aid while our trading partners have exploited the connection.

Related, and just as important, is the failure of the various government agencies that could provide export support for renewables to have any mechanism for coordinating their activities or for promoting consistency among their activities.

A graphic example of the lack of coordination occurred in the course of the recently completed Department of Commerce Solar and Alternate Energy Seminar Mission to Southeast Asia. From initial reports, the trip appears to have been a spectacular success in generating sales. At least one of the company participants on the trip, however has pointed out a disappointing lack of interest and participation by the local AID Missions during the in-country programs. Only through great effort and persistence, in fact, was the group successful in even meeting with an AID representative in the Philippines. The participant who brought this incident to my attention pointed out that it would have been extremely valuable to have AID representation at the seminars themselves so that the agency personnel could gain better knowledge of the U.S. technologies and their potential application to local country needs. It was also pointed out that local AID personnel could have been valuable in educating the company representatives on conditions and contacts in the country. In sum, he made a strong pitch for having AID involved with the planning and implementation of overseas missions of this sort.

The example of the overseas seminar mission is indicative of the problem at all levels of the bureaucracy. An interagency working group on renewable energy exports should be established with the Department of Commerce, AID, Eximbank, Trade and Development Program, OPIC, and State Department. This would help establish a more comprehensive, effective and efficient use of the government programs.

(5) *No focal point in the government for renewable energy export.* There is no high level official in the government responsible for, or expressing interest in, developing renewable energy exports. Without signals coming from "on high" from such a champion, it is very difficult to make the changes in government programs, and the coordination among programs, needed for U.S. companies to compete effectively against foreign government-supported competition.

The renewable energy industry is in a unique position. It must establish itself in the international market even while the technology is emerging and even before the domestic market is firmly established. This is an unusual situation for a U.S. industry, and the difficulty is compounded by the government support our competitors receive in their overseas marketing. It is important, therefore, that interest in developing renewable energy exports be established at a high enough level to make sure that U.S. programs are responsive to the particular needs of renewable energy companies.

TAX POLICIES

While my statement has focused on elements involved with international marketing of renewable energy, it is essential to emphasize also the critical importance of the domestic tax credits for renewable energy investments. As an indication of the importance of the credits, appended to their statement are documents submitted to us by two companies, comparing the economics of specific solar energy projects with and without the credits.

One set of documents, provided by Martin Marietta Corporation, pertains to the bidding for Southern California Edison's 100 MWe Solar Thermal Central Receiver Project. The schematic representation shows clearly the effect of the Energy Tax Credit: with the credit the project can be done now at today's energy prices. Without it, the project will have to wait until the price of energy is carried up at the whim of OPEC.

Similarly, American Solar King has provided us with information (also appended) about third party financing of industrial solar energy systems, demonstrating quite clearly that the rate of return without the Energy Tax Credit is insufficient to attract investors at a time when interest rates are relatively high and low-risk investments secure returns that are comparable to riskier renewable energy investments.

Finally, Mr. Chairman, I would like to submit for the record a copy of the Institute's recent publication entitled "The Impact of Recent Federal Tax Legislation in the Renewable Energy Industry." (The report's Executive Summary and Introduction are appended to this statement.) Among other things, this comprehensive report clearly shows how some aspects of the Economic Recovery Tax Act of 1981, and the Tax Equity and Fiscal Responsibility Act of 1982 have made renewable energy investments less attractive relative to conventional energy investments than they were under prior law. Legislation has been introduced by a bi-partisan group of Ways and Means Committee members (H.R. 7268) which would extend and enhance the renewable energy tax credits.

I think you will find the Institute's report helpful in understanding the context of, and the need for legislation such as H.R. 7268 in order to keep photovoltaics and other renewable energy technologies moving forward in the marketplace.

[Additional material submitted by Mr. Hayden is retained in subcommittee files.]

Mr. **Bedell**. Mr. Enfield.

STATEMENT OF SAMUEL E. ENFIELD, BUDGET POLICY ANALYST, SOLAR LOBBY

Mr. **Enfield**. Thank you. The Solar Lobby has been involved in photovoltaics to a considerable extent and I have enjoyed it and I want to associate myself with the remarks of Bob Hayden and Brad Mead. The Export Trading Company Act does look to be an awfully good prospect. It may take time to deliver and I think there is some lack of awareness of the technologies that will confront us in that area and other areas that I think may be a problem factor in promoting exports.

I do also want to compliment the Commerce Department for working really effectively in their trade development program with the renewable energy industry.

But today what I really want to address is the domestic R&D program. I think that can be viewed obviously in an international context. We have been hearing a lot today about what the competition is doing, particularly based on technologies that this country initiated over the last number of years. We haven't heard a good statistic on market potential. I have one that perhaps by 1986 the world market for installed systems, not just arrays, but systems, may be in the $800 to $900 million range.

Eighty to ninety percent of that has been estimated to be outside the United States. So we really are talking about a massive market and a real investment that America can make to meet that market.

I know I don't have to convince this subcommittee of the value of small business in innovation overall and in the PV program in particular. I would like to cite that the Solar Panel of the Energy Research Advisory Board came down very strongly on the same thing that the smaller industries involved in the research programs have really contributed. You have heard from a number of people today about the budget situation. As it is some of those companies are being squeezed out of the program, and I think that that, along with the current economic situation, is creating a critical situation for those small businesses.

It has been my observation based on conversations with a number of the smaller businesses in the industry that raising capital for commercializing processes is difficult. As Mr. Maycock said, it is almost nonexistent for further research and development. So I think that the problem is that without the R&D program, I have serious questions about the ability of the industry and particularly the smaller businesses to continue to pursue the technology development that is going to maintain our competitiveness.

My job is the budget for renewable energy R&D and so I have been sort of, so to speak, on the front lines of reductions in the last couple of years. It has been a rather discouraging process. There are a number of problems that are coming to light in the PV program, and others, in renewable energy perhaps as a result of it.

I think as we see the budgets coming down, we do see certain technologies not being addressed sufficiently. Occasionally internal political considerations drive resources away from those most promising developments. And one interesting situation that really has seemed to have occurred is that amount of funding within a program, the balance of funding I should say, between that which goes to small businesses involved in research, and that which remains in the labs who run the programs, has changed substantially, and it declined by a far greater extent for the businesses than it has for the labs.

I don't really want to criticize the labs. Obviously, they are a tremendous resource. They have demonstrated a great degree of excellence, they are important repositories of institutional memory, if you will, and they have a broad perspective on a technology and industry that businesses may not perhaps be able to duplicate, being more specially oriented toward particular products and particular portions of the program.

But the labs are very expensive at the same time, and I think as the budgets for the programs decline we need to take a close look at the design of the program, the structure of the program and the amount of money that is available to the smaller businesses. They theoretically are going to take the technologies into the market and really carry us in the domestic and world market. I contrast that to the more in-house type of work that goes on at the laboratories.

I think it is my impression that the program all along has been oriented toward getting an industry going that could go out and market in the United States and abroad and I think when we are faced with a budget reduction, we have got to keep that in mind. I think this budget reduction that we are facing now makes it important that we examine the situation between the labs and between companies and make sure that the balance is proper.

I know there have been studies on funding from DOE going to small businesses. It has been a subject of considerable interest. I don't know how much of that has been oriented toward examining the role of the research firms in the program, but I think it might be a really useful service for the subcommittee to examine through a General Accounting Office study—to look at the program the way it is designed, the way it is structured between the smaller businesses and between the labs and DOE here in Washington—and to get an idea as to the productivity of the varying elements of the program and to rationalize the balance of the program from here on among these various elements.

I would certainly be willing to cooperate with the subcommittee in that effort and I certainly think it may help us in the future. I will put it this way. If we can't reverse the funding trends that we face, then I think that is going to become particularly important.

It would help us if we maintained the balance in the program. I think it would help us in the future to get the most of the programs that we do have.

Thank you.

[Mr. Enfield's prepared statement follows:]

PREPARED STATEMENT OF SAMUEL E. ENFIELD, BUDGET POLICY ANALYST, SOLAR LOBBY

Mr. Chairman, members of the Subcommittee, my name is Sam Enfield. I am Budget Policy Analyst for the Solar Lobby. As such, it is my responsibility to monitor the funding levels of the DOE Renewable Energy R&D Program, to prepare recommendations of funding levels for that program, and to promote these recommendations before Congress.

Mr. Chairman, I want to express my appreciation for your interest in this area, and for your willingness to devote your time to examining the U.S. photovoltaics program.

The urgency of this subject is clear to us all by now. Numerous studies have documented the tremendous growth of support for photovoltaics research, development and, perhaps most importantly, commercialization among other industrialized nations. The DHR study, a report prepared for the House Science Subcommittee on Energy Development and Applications by R. R. Ferber of the Jet Propulsion Laboratory, and an accounting of foreign energy R&D spending prepared by TPI, Incorporated of Beltsville, Maryland, thoroughly document the increasing competition the U.S. is facing in the development of photovoltaics. Not only are foreign government investment in photovoltaics development substantial in financial terms, they are also oriented toward the early commercialization of photovoltaic technologies. They are, in fact, modeled after the photovoltaics program conducted by our own government, previous to the inauguration of the current Administration.

I think it is important to keep in mind that the technologies being pursued overseas are technologies that, for the most part, originated in this country. It is ironic that we now face such stiff competition in areas that we ourselves pioneered. I cannot believe that, were the program changes proposed by the Administration to be adopted by Congress, history would treat kindly the squandering of our investment in this promising field. Not only do we need to continue the domestic development of secure and economical energy supplies, for both the near and more distant future; we also badly need to maintain our competitive advantage in this technology that is being embraced so enthusiastically by the world. Thus it is a dual context in which we view the urgency to continue development of photovoltaic technologies.

If the current debate over U.S. energy policy was truly that—a policy debate—I would feel far more sanguine about our prospects for continuing the timely development of photovoltaics, and of the many other promising renewable energy technologies. I have learned, however, along with almost everyone else who has endured the last two budget cycles, that we are caught up in a numbers game. Policy, perhaps most strikingly in the energy area, has been driven by political and budgetary goals. The free market rhetoric that suggests that the only proper federal role in renewable energy development is to support long-range high-risk research is strangely silent during debate over some very near-term element of our nuclear research programs or the continued tax support of our well-established oil and gas industry.

The Congress, in all fairness, has rejected some of the drastic cuts in renewable energy funding proposed by the Administration, and has similarly rejected the proposed elimination of the renewable energy tax credits that are so critical to the commercial development of both business and residential renewable energy applications. While the reductions that have been imposed on the renewable energy R&D program overall, and on the photovoltaics program in particular, are greater than they should be, Congress has maintained a balance between near- and long-term development efforts that is essential to realizing the benefits of the investment we have made to date.

This, then, is the context in which we view the photovoltaics R & D program at this time: funding reduced by over one half in 1982—and that level likely to be reduced by more than a fifth in 1983; increased competition from overseas in both research and marketing support, and extraordinarily tight private capital markets which cannot, at the present time, compensate for lost federal funding. Small photovoltaic businesses, whose innovative nature and employment-creating potential have been widely demonstrated, are suffering the most in this climate.

Despite the liberalization of patent rules, which now allow small businesses to retain more of the patent rights to federally-supported developments, raising capital to sustain ongoing work is extremely difficult in today's economy. Because photovoltaics are so critical to the nation's energy future; because photovoltaic technologies offer this country at least a partial solution to its economic problems, and because small businesses are so important to the continued progress of our photovoltaic development effort, this hearing is especially timely and appropriate.

Access to capital is the greatest problem for small photovoltaic companies. Capital is required both to pursue research and product development, and to build production capacity that will permit them to take advantage of developing commercial markets. I do not necessarily believe that small business will become major suppliers of photovoltaic cells and modules, but the almost infinite variety of possible photovoltaic applications will provide plenty of opportunities for small businesses to develop and successfully market photovoltaic production equipment, systems and system components. Thus their continued viability, in substantial numbers, is essential to the full development of the U.S. photovoltaic industry. It is toward assuring that continued viability that we should devote serious effort.

It is difficult, at this time, to detect any real attrition among small photovoltaic companies resulting from the budget reductions of the last two years. There are, however, disturbing signs that private capital sources are insufficient to allow small photovoltaic businesses to continue the kind of technology and product development efforts that are so important to maintaining the U.S. lead in photovoltaics. From conversations I have had with members of the small photovoltaic business sector, it appears that companies are being forced into other technology areas to find funding to support their continued existence. Companies are also being forced to devote more effort toward exploring overseas markets, for their current technology systems and, perhaps more significantly, for their technologies themselves. It is not that I oppose product diversification or overseas marketing; to the contrary, I applaud both. However, when companies are forced for financial reasons into these directions, to the detriment of further development work so critical to increasing the efficiencies and reducing the costs of their systems, the overall U.S. effort suffers. In a field as promising as photovoltaics, one would certainly think that resources adequate to sustain the industry's development can and should be made available. If the private sector cannot fully accomplish that—and it cannot at this time—the federal government should. It is clearly in the national interest, and is an investment that, I think, will pay for itself many times over.

The Reagan Administration has even acknowledged the federal role in meeting development needs which the private sector cannot address. In their program justifications, this is only supposed to occur in the areas of long-term, high-risk research. As I stated before, I believe that their program proposals are driven by overall budgetary considerations. Thus I am not optimistic that they would be sympathetic to the contention that higher funding levels are required, let alone justified, to support the level of industry involvement in nearer term photovoltaics development that is needed.

Given the budgetary restraints, then, that we face now and probably will continue to face, I think that we should look to structural improvements that can be made in the photovoltaics program to maintain industry participation at an adequate level. It has been my observation that, as the overall photovoltaic program funding level has decreased, the balance between the workload of the laboratories (SERI, Sandia and Jet Propulsion) and of the companies they contract with has changed. While the absolute levels of both the in-house lab work and the industry-performed work have decreased, the companies' share has decreased substantially more. This, despite the small business set-aside program enacted through the Small Business Innovation Development Act of 1982, for which we have to thank you, Mr. Chairman, has exacerbated the capital shortage of small photovoltaic businesses.

There are a number of ways in which this situation can be addressed, and I must admit that I am not prepared at this time to recommend any one in particular. The balance between in-house laboratory work and industry-contracted work might be manipulated, so that a greater proportion of our reduced budget is allocated to industry. This would lead to a greater share of the research budget being made available to the smaller companies. While I am respectful of the tremendous technical and managerial resource that the national labs represent, I am concerned, as well, about the expense that they represent, particularly in the context of a greatly contracted budget. Keeping in mind that it is the industry, after all, that will ultimately accomplish the commercialization of photovoltaics, I feel that we should take particular care to ensure their role in the maturing photovoltaics program.

We could also work to make a greater share of the industry-contracted work available to small companies. This, I believe, was suggested by Dr. Berman of the Solar Energy Industries Association in his testimony on the 1983 photovoltaics program before the Science and Technology Subcommittee on Energy Development and Applications. Another suggestion made by Dr. Berman at that time was to establish a Center of Excellence at SERI, to which companies, including small research companies, could send researchers to work for periods of time at government expense. This proposal, as I see it, would address a number of objectives: it would enrich the in-house laboratory research program; it would enhance technology transfer to industry, and it would help small businesses carry the expense of their research staffs.

All of these suggestions, I believe, deserve consideration, and I would hope that you might elicit opinions on them from those who have testified here today, as well as from others who are interested. I, certainly, would be more than willing to work with you and your staff in this regard.

Again, I am grateful to you for taking time during this very busy post-electoral session to explore this broad range of issues. I am aware of your great interest in photovoltaics, and in the tremendous potential they offer to this country and to the world. I certainly share your desire to maintain the vitality and momentum of the photovoltaics development program of the United States.

Mr. BEDELL. Thank you very much. I appreciate the way all of you have summarized your statements. We will take just a minute or two.

Mr. Berman, you indicated that in your opinion we are ahead of the rest of the world in photovoltaic industry development.

Mr. BERMAN. Yes.

Mr. BEDELL. Of others?

Mr. BERMAN. Yes.

Mr. BEDELL. If we continue to decrease the funding through the Departments of Energy and Commerce and other agencies for export help, if we continue our present governmental policies, do you believe that our photovoltaic industry will be able to grab hold enough to be able to continue to stay ahead of our foreign competitors?

Mr. BERMAN. I think it is a horserace in that case, because I think there certainly is help that industry could use for everyone that was funded by the Government, and in my opinion some of those decreases make some sense to me. A lot of them don't. There has been a substantial increase in the amount of research money spent in industry over the last few years.

Mr. BEDELL. If I understood your testimony correctly, it indicated that foreign governments are giving significantly more support to their exporters in terms of promotional activities and funding than our Government is.

Mr. BERMAN. That is right.

Mr. BEDELL. Do you see this as a serious problem or do you think it is something that our industry will be able to compensate for?

Mr. BERMAN. I think it is a problem. The problem isn't in making the product, it is in getting it sold.

Mr. BEDELL. Mr. Hayden, you indicated that you think Government ought to be more of a coordinator in the photovoltaic effort. Is that what you were saying?

Mr. HAYDEN. Essentially yes.

Mr. BEDELL. How would you propose that should work?

Mr. HAYDEN. One immediate step that could be done would be to establish an interagency working group between the different agencies having some role to play in export activities in the renewable energy area.

Mr. BEDELL. Do you agree with Mr. Berman that it is a serious problem that foreign countries are giving much more support to their companies in terms of export activities as compared to the United States?

Mr. HAYDEN. Yes, I think it is a very serious problem.

Could I add a brief comment, too?

We have talked about the types of governmental roles in supporting the export market. Just as important is continuing the viability of the domestic market because renewable energy companies have to be selling here. This ultimately is their base market.

The key to that right now is the area of the tax credits. There are energy tax credits in place over and above the industrial investment tax credits. Those tax credits continue to be threatened by the administration. Every time they are threatened, solar energy projects around the country get shelved, and frozen.

For new projects to go forward, a little extra boost is needed to get the financial backers involved in the private marketplace. That is a terribly important issue that we have not addressed, but I would hope the Small Business Committee recognizes the need to keep the tax credits in place for a little longer until the industry can move totally on its own.

Mr. **Bedell**. Mr. Enfield, Mr. Tribble testified that although DOE funding has been cut in half or more in our photovoltaic efforts, the research had really not been particularly cut at all. Do you share that statement or would you like to comment on it?

Mr. **Enfield**. I think you were getting at the point when you brought up the ribbon work that had been terminated. That may not be interpreted as basic research. If you don't want to interpret that as research, you don't have to. I think a lot of creative semantics have been used to justify certain activities. I have seen that there has been substantial reduction in the kinds of activities that will bring technologies to the point where they can succeed commercially, and it really should go beyond basic research.

Mr. **Bedell**. We do the basic research, then the Japanese take it and commercialize it.

Mr. **Enfield**. And do the technology.

One of the other justifications the administration used, and we heard Mr. Tribble say it, he believes there is private capital available to fund work beyond basic research.

I think Mr. Maycock testified to the fact that there are companies he is working with for which that is not the case, and I agree with him on that. If that is the case, then I think the administration's argument—there may be room for a meeting of the minds.

If the administration can be convinced that there is insufficient private financing available for technology development and for prototype development, for the work to bring the technologies to the point from which they can proceed commercially, then perhaps they can buy into a bit more balanced, a bit broader renewable energy, and photovoltaics in particular, programs.

I think for this committee's interest, clearly for the small businesses, that money is not there. Perhaps for some of the larger companies involved in the research that is there, but I think for the sake of the small businesses which have done so much for the technology, capital availability is a standard that we should be using rather than basic research versus applied research, versus technology development. That is the standard that we could use.

Mr. **Bedell**. I do not understand exactly what you were getting at when you talked about the balance between labs and small businesses. What do you mean by labs?

Mr. **Enfield**. There are three labs involved in the photovoltaics program.

Mr. **Berman**. He means Government laboratories.

Mr. **Bedell**. I am sorry, I do not understand what you meant. I take it it is your belief that the money could be more effectively spent, given its limited availability, with some of the small businesses, rather than with the labs. Was that your point?

Mr. **Enfield**. I am observing that the labs administer the program. The money goes from DOE to the labs who run the components.

Mr. **Bedell**. Jet Propulsion Labs?

Mr. **Enfield**. Right, Jet Propulsion, Sandia, and SERI. Since they have substantial control over their program elements, they are in a sense bureaucracies administering a program and they have an inertia and agenda of their own.

I have observed that as the budget comes down they take less of a cut than the companies do. I do not know where the precise dividing line is, but I know that a lot of the companies which have been involved in doing good work and contributing are getting squeezed out and they think that is part of the problem. I am suggesting in a declining budget we should keep an eye on the balance of the program's proportions, labs versus industry, and try to keep the balance right.

Mr. **Bedell**. I certainly appreciate your being here. I appreciate that you stayed so long. I thank all of our witnesses that have been here today. I appreciate the way the audience has stayed for this long time as well. It shows the considerable interest in this particular issue. The hearing record will be left open for 1 week for any additional comments or statements that anyone wants to submit.

Thank you very, very much.

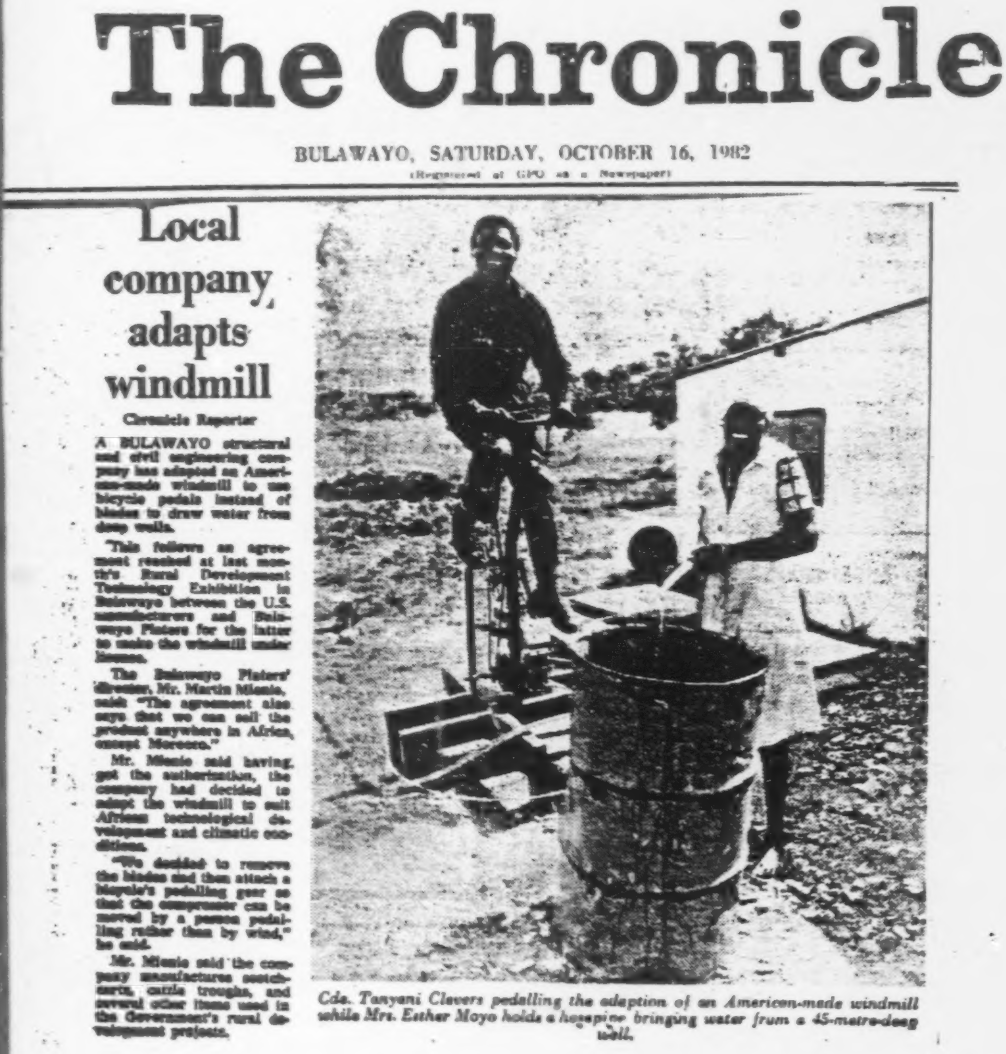
The hearing is adjourned.

[Whereupon, at 5:10 p.m., the subcommittee adjourned, to reconvene subject to call of the Chair.]

APPENDIX

APPENDIX A.—ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD BY RICHARD L. DICICCO

EXHIBIT 1



The Chronicle

BULAWAYO, SATURDAY, OCTOBER 16, 1982

(Registered at GPO as a Newspaper)

Local company adapts windmill

Chronicle Reporter

A BULAWAYO structural and civil engineering company has adapted an American-made windmill to use bicycle pedals instead of blades to draw water from deep wells.

This follows an agreement reached at last month's Rural Development Technology Exhibition in Bulawayo between the U.S. manufacturers and Bulawayo Platers for the latter to make the windmill under licence.

The Bulawayo Platers' director, Mr. Martin Mlonie, said "The agreement also says that we can sell the product anywhere in Africa, except Morocco."

Mr. Mlonie said having got the authorisation, the company had decided to adapt the windmill to suit African technological development and climatic conditions.

"We decided to remove the blades and then attach a bicycle's pedalling gear so that the compressor can be moved by a person pedalling rather than by wind," he said.

Mr. Mlonie said the company manufactures scotch-carts, cattle troughs, and several other items used in the Government's rural development projects.

Cde. Tanyani Clevers pedalling the adaption of an American-made windmill while Mrs. Esther Moyo holds a hosepipe bringing water from a 45-metre-deep well.

EXHIBIT 2

AN ENERGY RESOURCES COMPANY **Bowjon International, Inc.**

November 15, 1982

Congressman Berkeley Bedell
House Small Business Committee
B363 Rayburn
Washington, D.C. 20515

Dear Congressman Bedell:

First let me congratulate you on your re-election which delighted me and all interested in alternative energy technology.

Secondly I'm writing to say good things about the Appropriate Technology International's activities in promoting the World Development Trade Fair in Zimbabwe this past September. As a private enterprise manufacturing a wind machine for water pumping, we were delighted that a unit was installed by ATI at the fair with considerable success. The enthusiasm for our unit will probably result in a licensing or joint venture agreement.

Private businesses such as ours are desperacely in need of liason help of this sort. Whatever you can do to perpetuate and expand this aid would be most welcome.

Sincerely yours,

BOWJON INTERNATIONAL, INC.

Bryce Bowmar
President

BB:nh

cc: Rich DiCicco

EXHIBIT 3

Industrial Services International, Inc.

TELEX 89–8388 (AEMPOWER/WHEN)
P.O. Box 10834 ▪ Bradenton, Florida 33507 U.S.A. ▪ Phone (813) 792-7778

October 6, 1982

Mr. Peter Mc Pherson
Director
U.S. Agency for
International Development
Washington, D.C. 20523

Dear Mr. Mc Pherson:

I recently returned from The International Exhibition of Rural Developmet Technology Trade Fair, held in Bulawayo, Zimbabwe, September 15-20, 1982. The exhibition was unquestionably the most valuable we have ever attended. Thanks to your agency's support, our company and products were well received by potential users, government officials, marketing firms and manufacturers.

I especially wish to commend the performance of Mr. Roy Stacey, Director of the A.I.D. Mission to Zimbabwe, for his most helpful ways of introducing me to President Canaan Banana and other important leaders in government and private industry. His insights into the economic and business workings of these southern African countries have given us a far better perception of how to develop a workable business arrangement, under difficult local conditions.

We are now prepared to enter into business arrangements which will not exploit these countries, but rather strengthen their economies and increase their exports through increased agricultural outputs and local manufacturing.

We have signed numerous letters of intent with firms in Zimbabwe. I am confident that the exhibition in Bulawayo will lead to much business for our firm, goodwill for America, and will ultimately strengthen our relations in the fragile economies of these sensitive countries.

Again, our many thanks to your organization for its invaluable support. We would welcome the opportunity to work again with A.I.D. in the future. Please do not hesitate to call on us if we can ever be of service.

Respectfully,

INDUSTRIAL SERVICES INTERNATIONAL, INC.

James J. Quinn
President

JJQ:ps

cc: Mr. Roy Stacey, Director
U.S.A.I.D. Mis[illegible] to Zimbabwe

EXHIBIT 4

Solar Electronics
156 Drakes Lane
Summertown, TN 38483
(615)964-2222

November 24, 1982

Hon. Berkley Bedell
Chairman
Small Business Subcommittee on Energy
B-363 Rayburn House Office Bldg.
Wahhington, DC 20515

Dear Representative Bedell,

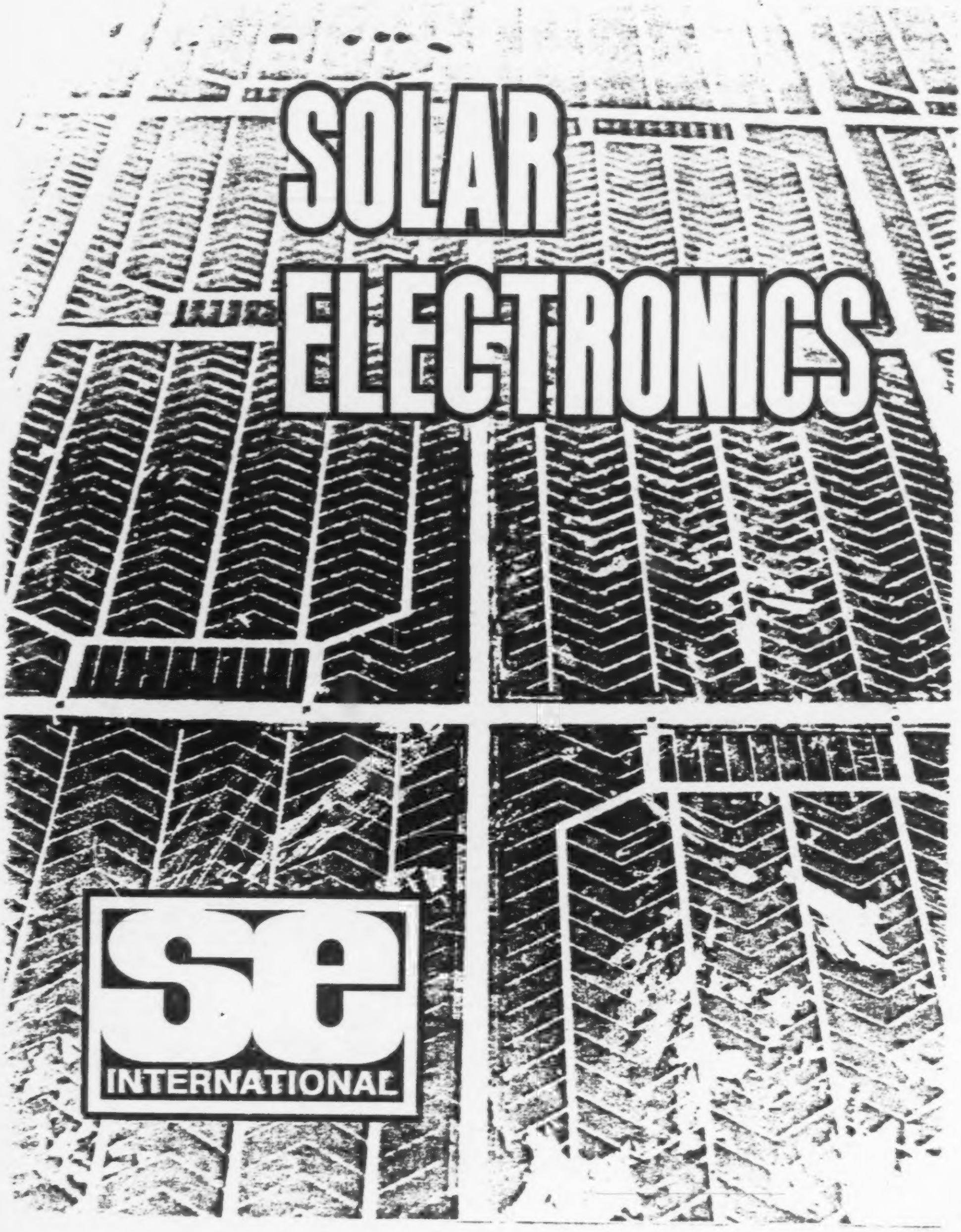
I am writing you thiseletter in support of the testimony that is to be given by Richard DiCicco on December 9th before your subcommittee. Recently it was my pleasure to have been a part of the United States exhibition at Rural Development Technology '82 held in Bulawayo, Zimbabwe during September of this year. We, Solar Electronics are a small electronics firm that designs and installs photovoltaic power and communication systems. We exhibited a solar-powered two-way radio system and a small photovoltaic array. For businesses such as ours, trade fairs like this one are the perfect opportunity to reach the new markets and to introduce this new technology. In Zimbabwe, the response from those attending was very positive, and overall the fair was verybeneficial to our company's growth.

It is our hope that the United States continue to participate and help coordinate exhibitions such as RDT '82. Our technological leadership is also a responsibility to transfer that technology to the developing world.

Sincdrely,

Richard McKinney

EXHIBIT 5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INTERNATIONAL

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OPENING NEW FRONTIERS IN RADIO

In remote areas, beyond the reach of conventional telephone and power lines, ***SOLAR ELECTRONICS*** Radio Systems offer:

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- ★ **WEATHER-PROOF MODULAR DESIGN**
- ★ **TOP-NOTCH QUALITY COMPONENTS**
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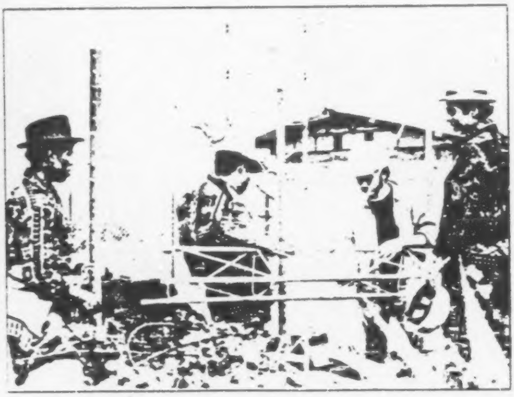
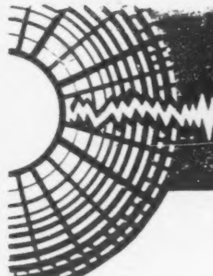
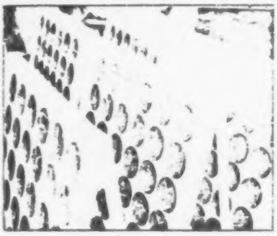
Every ***SOLAR ELECTRONICS*** Radio System is backed by the international expertise of our large staff of First Class Commercially-Licensed radio technicians. Over the last ten years, we have provided technical consultation and field work in Bangladesh, developed emergency communications facilities in Guatemala, installed and maintained radio and navigational systems in the North Atlantic, and completed FM broadcast feasability studies and installations for remote areas in the US and overseas. One recently completed project in Central America established a village-to-village communications network on VHF-FM consisting of 10 solar-powered stations scattered throughout the jungle, in an area previously without any form of rapid communication.





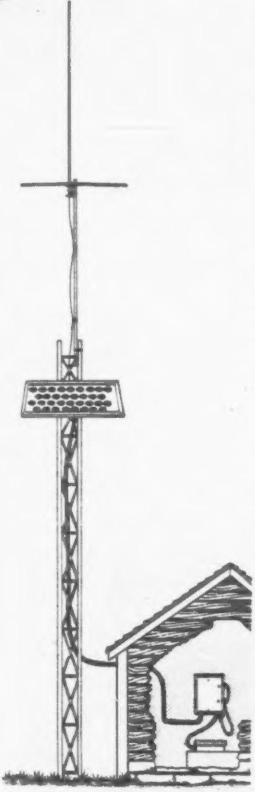
COMMUNICATIONS

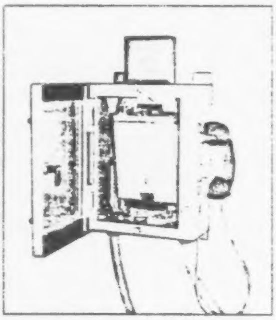
EACH SOLAR RADIO CONSISTS OF:



The Antenna is pretuned for maximum performance on the selected frequency of operation. The type of high gain antenna used is either directional or omnidirectional, depending upon the specific needs of the station.

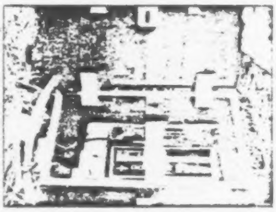
The Photovoltaic Array is sized to meet the daily load requirements of the radio equipment. The solar panels used in the array are manufactured by the technical leader in the photovoltaic field. For long panel life they have textured, tempered glass faces with anodized frames and support structures, and the solar cells are encapsulated in silicone rubber.





Radio Transceivers may be HF, VHF or UHF, offering from local to worldwide radio coverage. The radios are tuned to the frequencies allocated for use and are aligned to provide maximum performance on transmit and receive. Where necessary, radio units are contained in rugged, tamperproof enclosures, protected from adverse weather conditions by water- and dust-tight seals. All radios are electrically protected by resettable circuit breakers. For some installations, a durable push-to-talk handset (connected by an armored cable) is the only element of the radio exposed outside of the enclosure.

Wire Harness. Where appropriate, the wiring between components is entirely protected from exposure to weather and other harsh environmental conditions by *seal-flex* armored weather-tight conduit.



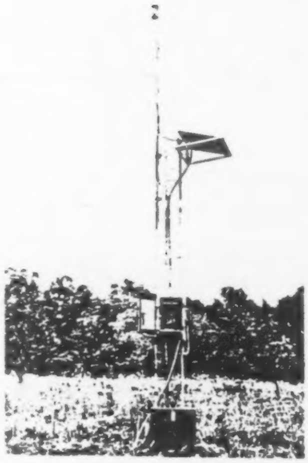
Battery Packs are made up of one or more batteries designed specifically for use in photovoltaic applications. Battery packs are sized with ample capacity to supply normal operating power to the radio over several sunless days. For maximum usable life, batteries are protected from overcharge and excessive discharge by voltage regulators. The batteries themselves are located within lockable, corrosion-proof containers.

These stations are ideal for any location where an independent power source is desirable. Any solar radio system can be expanded with the addition of compatible mobile, portable or hand-held radios for full communications coverage wherever needed. Typical base-to-base coverage on VHF is within a 30-mile range, depending on terrain. Any system's effective range can be extended with the addition of our solar powered repeater station, when installed at a high centrally-located site.

Our systems are manufactured to keep technical fieldwork to a minimum. All electronic adjustments necessary are completed at our factory. Polarized snap-lock connections and factory assembled modules are provided so that on-site assembly can be accomplished by people with a minimum of technical expertise. Complete assembly and maintenance instructions are included with each system.

In order to insure that our systems achieve maximum effectiveness after installation, accurate and detailed information concerning these factors must be supplied to us in the design stage:

- ★ **Topographical Features**
- ★ **Distance Between Stations**
- ★ **Duty Cycle (Transmit/Receive)**
- ★ **Climatic Conditions**
- ★ **Frequency Allocation**
- ★ **Specialized Requirements**



SOLAR ELECTRONICS provides consultation and design services in communications and alternative power applications for use throughout the world. We specialize in remote installations. Our specific installation capabilities include:

- ★ **Solar Generators**
- ★ **Wind Energy Applications**
- ★ **Solar/Wind Water Pumping**
- ★ **Marine Radio and Navigation Systems**
- ★ **Village Communications**
- ★ **Remote Broadcast stations**
- ★ **FM Repeaters**
- ★ **Paging Systems**

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PORTABLE COMMUNICATIONS SYSTEMS

and distribute:

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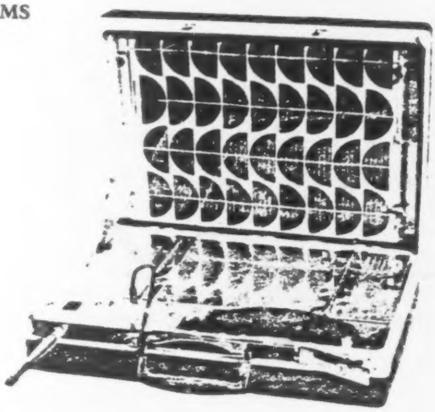


Rural Development Technology Exhibition Report

Africa's first-ever rural development show – a success

They came from far and wide!

By the close of the first-ever Rural Development Technology Exhibition held in Bulawayo (15 – 19 September 1982) 8779 visitors had attended the show. These were genuinely interested people who, in some cases, had travelled thousands of miles to see the first-time event. A list of countries represented appears inside.

This was the first time an exhibition in Africa had been devoted wholly and exclusively to the problems of the peasant farmer and his family. It is the expressed aim of all countries in the Southern African Development Coordination Conference (SADCC) to upgrade living standards in rural areas. RDT82, which was supported actively by each of the nine member nations, was judged to have gone a long way to achieve this improvement.

180 exhibitors from 17 countries gathered in Bulawayo to show some of the products and processes which are available to make life better for the ordinary villager. The result was a surge of business which delighted the Governments of the supporting nations and the individual companies who were participating in the show.

In his opening address, H E The President of Zimbabwe, Rev The Hon Canaan Banana endorsed the aims of the exhibition and encouraged the exhibitors and visitors to exploit the initiative of the organisers in staging RDT82 "This is more than an exhibition" he claimed "It is also a demonstration. It is a demonstration of the cause of optimism. For in these showgrounds we have the living evidence of man's awareness, his ingenuity and his concern for the technical advancement of mankind . . . As you go round the exhibits I hope you will feel, as I do, a renewed determination to defeat the problem of poverty and move on with ever greater confidence to the fulfilment of the promise which these displays exemplify."

Since the successful conclusion of RDT82, the organisers have announced their plans for the future. The 2nd International Exhibition for Rural Development Technology will be staged in Bulawayo in September 1984, but an important international conference on the same theme is to be held in Harare next year. See inside for details.

His Excellency The President of Zimbabwe, **Rev The Hon Canaan Banana** officially opens the first **International Rural Development Technology Exhibition** in Bulawayo on 15 September 1982. Looking on are (left to right) **Mr Arthur Blumeris,** Executive Secretary, Southern African Development Coordination Conference (SADCC). **The Hon Moven Mahachi,** Minister for Lands. Resettlement and Rural Development and **Mr Jimmy Skinner,** Director of ZIIE Pvt Ltd. organisers of the exhibition.

Rural Development
Technology 82

The International Exhibition
of Rural Development
Technology
Showgrounds Bulawayo
Zimbabwe
15-19 September 1982

Top level visitors to RDT82

The upgrading of living standards in rural areas is the expressed aim of the Zimbabwe Government. It was with the full support and active backing of this Government (together with the other SADCC nations) that the exhibition took place. To endorse its objectives, no fewer than 16 Cabinet Ministers attended the show.

Among these ministers were The Hon Moven Mahachi, Minister for Lands, Resettlement and Rural Development, Senator Enos Nkala, National Supplies, Dr Simba Makoni, Industry and Energy Development, Mrs Teurai Ropa Nhongo, Community Development and Women's Affairs, Mr Cephas Msipa, Water Resources and Development, and Mr Ernest Kadungure, Youth, Sport and Recreation.

Seen here, being greeted by Mr H B G Montgomery, Director of ZIIE Pvt Ltd are (left to right) Senator Enos Nkala, Minister of National Supplies, Mrs Tsitsi Munyathi, Deputy Minister of Education and Culture and Dr Simba Makoni, Minister of Industry and Education.

Who they were and where they came from

RDT82 attracted visitors from all over Southern Africa. Among those attending were 118 agricultural officers, 78 District Council officials, 157 National Government officials, 18 industrialists . . .

27 countries were represented in the 8779-strong audience. These were: Angola, Australia, Belgium, Botswana, Burundi, Canada, Cyprus, Denmark, France, Gambia, Germany, India, Italy, Kenya, Malawi, Mozabique, Nigeria, Sierra Leone, South Africa, Sweden, Tanzania, UK, USA, Uganda, Upper Volta, Yugoslavia, Zambia.

Britain's Central Office of Information built the second largest stand in the hall to their own original design. It attracted a continuous stream of visitors to see the 23 different different exhibitors from the United Kingdom. Business was brisk particularly for Innes Walker Leisure whose food smoking units and graining cleaning machinery were in great demand. Richard Evans of ITIS said "This show has been extremely successful in attracting the ministries and businessmen who the companies on the UK stand wanted to meet. We are very pleased with the way it has gone."

The Association for the Promotion of Exchanges of Food Products and Agricultural Technology – ADEPTA brought a group of seven major French companies to exhibit on their stand. Their interests covered every aspect of rural development from large industries to small-scale rural production and processing. One participant, Agralco, is the specialised subsidiary of a group of 22 basic farming cooperatives in France. Caroline Pol leading the Adepta group said "We are very proud that France is here."

The German Appropriate Technology Exchange (GATE) built an eye-catching structure of poles and bouganvilleas to house their display of the work done by GATE. As the section of GTZ – the German Government's aid administration – most concerned with rural development, they are active world-wide. A spokesman for GATE said "We have achieved all our objectives at RDT. The visitors were from all our target groups."

The Centre for Industrial Development had invited 10 European and one Zimbabwean company to exhibit on its stand. CID was established in Brussels under the Lomé Convention with the specific aim of fostering partnerships between industries based in EEC and ACP countries. David Ogilvie who was in charge of the stand said "The exhibition has provided an excellent opportunity for meeting businessmen, not only from Zimbabwe but also from the SADCC countries. We have been able to initiate a number of joint ventures with European companies, to promote our technologies adapted to African conditions and to complete arrangements for training people from six enterprises in Zimbabwe and Botswana in Europe and in Kenya. The Exhibition has greatly strengthened the practical links between the EEC and Southern Africa."

A full seminar programme

Running concurrently with RDT82 was a series of seminars in a variety of forms. Each SADCC country had its own appointed national day on which they were free to host lecture and discussion sessions on their particular rural requirements and problems. These programmes were often lively and informative, in particular Tanzania whose description of the Small Industries Development Organisation was particularly interesting and Botswana's well-presented survey reflected the wide range of exhibits on their stand. The representatives from Angola and Mozambique were in particularly strong demand as contact with these two countries is still difficult.

Organisations also held symposia on wide ranging subjects. The Institute of Agricultural Engineering of Zimbabwe (sponsored by Stewarts & Lloyds) ran a very well-attended symposium on wind power. The seminar on small-scale mining, organised by AGID and sponsored by UNESCO, also brought a good international attendance. In both cases the meetings were complementary to inspections of the many exhibits of windmills and mining machinery respectively.

Other meetings also aroused great interest, particularly those arranged by ITDG by the Commonwealth Secretariat and by the Centre for Industrial Development on renewable energy and on adapting technologies to the needs of African countries.

Several individual exhibitors were also able to hold small workshops for anything up to 50 people on topics ranging from beekeeping and food smoking to low-cost building and small-scale production of chemicals and disinfectants.

Here Mr Joseph Forgats, Director of Housing, Maputo, Botswana speaks on rural development specific to his country.

The film of the show

The Ministry of Information in Harare wished to record the events of RDT week and therefore commissioned their own film team to document the show. This film is to be made available to exhibitors, visitors and any other interested parties. Anyone wishing to show the film should contact either ZIIE in Harare or the Ministry itself.

Reactions from exhibitors

A first-time event such as RDT needs close analysis not only by exhibitors but also by the organisers themselves. Results need to be evaluated and reactions logged in order to create an even greater success next time around. With this in mind, ZIIE asked all participating countries and companies for their assessment of the show. Some interesting results were recorded. For instance . . . *94% said at RDT they had met the people they wanted to see, 90% said they had achieved their objectives and 84% said they required larger or similar sized stands for 1984.*

And their comments . . .

"We would like to congratulate you on the organisation of RDT. Our participation was very worthwhile and we made many valuable contacts at the show." Stewarts & Lloyds.

"The amount of interest shown at RDT has been very good indeed." Botswana.

"We saw lots of district councillors and other public-life figures – just the people we wanted to meet." ACAT.

"We had lots of enquiries. One man from Zambia even paid cash for a blockmaker on the stand!" Electrical Engineers.

"The interest shown in this exhibition is phenomenal." W R S.

"It's been well worth the trip – a very successful show." Lifewater Systems.

"I took $10m-worth of orders in the first three days." Speedblock.

"We saw people from all over Africa and made lots of sales too." Jaros Jin.

"This is one of the best shows we've ever been to. The attention level of all visitors was very good." Industrial Services International Inc.

"The organisers are to be complimented on the excellent job done." Western Solar.

"Very pleased with the exhibition." Blue Ribbon Foods.

"We're very pleased with the genuine interest shown by visitors." Zimbabwe Castor Oil Products.

"The organisation impressed us greatly." Ames Engineering.

"We've been highly satisfied with the organisation and the exhibition in general." Bulawayo Steel Products.

"At RDT, we've had a wonderful opportunity to meet school teachers and rural leaders – and they're the ones we're aiming at." BAS H I Section.

"Well done!" Department of Natural Resources.

And in the future?

"I am pleased to hear that the second international rural development technology exhibition will be organised here in Bulawayo in 1984." So said Exhibition Patron, His Excellency President Banana in his inaugural address at the opening ceremony. For many it was the first time they had heard plans for the future of the show but, confident in the success of the 1982 event and encouraged by the longer lead-in time till September 1984, the organisers announced the dates to be 19 – 23 September 1984.

Additionally, since the outstanding conclusion of the show, the organisers have been discussing with the Minister of Lands, Resettlement and Rural Development the possibility of staging a major international conference in Harare in the intervening years.

This is now being planned for September 1983.

Said ZIIE Director, Jimmy Skinner, "I am very excited indeed about the conference's prospects. In this way, we can all – exhibitors, organisers, visitors, ministries and even governments – capitalise on the previous year's experience. We can exchange views, follow up leads and, as Minister Mahachi said at the opening of RDT82 "ensure that all the work in 1982 was not in vain and that it will not be a five-day wonder."

It is intended to invite speakers to talk on selected themes including promotion of regional and international trade, transfer of technology, information and communication in rural communities, tradition and innovation.

Said Mr Skinner "The exhibition will show the technology that is available for changing living standards in rural areas whilst the conference will concentrate on how to make those changes happen."

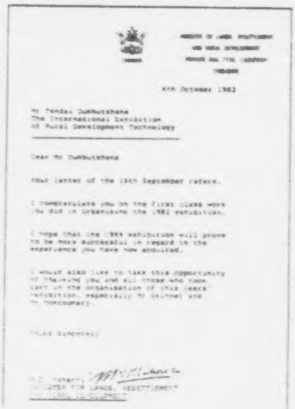
A card is enclosed with this newsletter. Please return it to ZIIE for further conference details.

The Prime Minister of Zimbabwe, The Hon Robert Mugabe, spent an interesting time at RDT discussing developments and products with the exhibitors.

Here he is seen with his wife Sally talking to Richard Evans, Commercial Manager of ITIS on the British stand.

"I congratulate the organisers in taking the initiative with RDT. The Exhibition responded very positively to the great needs and aspirations of the farmers of Southern Africa. It represented a remarkable and historical gathering of the industry and I wish the event every success in the future."

Mr Arthur Blumeris, Executive Secretary of SADCC at the Official Opening of RDT82.



4th October 1982

Mr Tendai Dumbutshena
The International Exhibition
of Rural Development Technology

Dear Mr Dumbutshena

Your letter of the [illegible] September refers.

I congratulate you on the first class work you did in organising the 1982 exhibition.

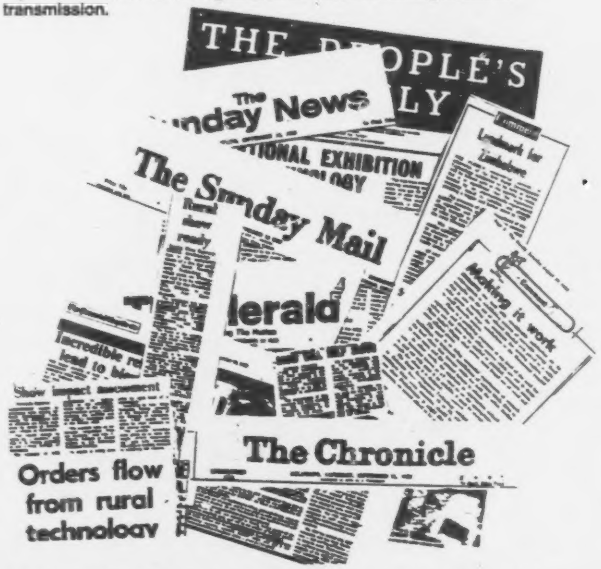
I hope that the 1984 exhibition will prove to be more successful in regard to the experience you have now acquired.

I would also like to take this opportunity of thanking you and all those who took part in the organisation of this years' exhibition, especially Mr Skinner and Mr Montgomery.

Yours sincerely

M.C. Mahachi
MINISTER FOR LANDS, RESETTLEMENT
AND RURAL DEVELOPMENT

The press coverage given to RDT82 was formidable. Reports appeared daily in both the Chronicle and Herald and national radio and television reporters were on site during most of the show recording details for transmission.



Both the Herald and the Chronicle ran exhibition supplements on the day before RDT opened. These highlighted products on show and gave details of events for the week. Among the other major African journals to give considerable coverage to the event were Africa Economic Digest and Africa Magazine.

International Press Services of Rome – an agency servicing some 400 papers worldwide – has distributed the good news of RDT to its whole mailing list.

Since the close of the exhibition, more articles have been appearing in national Zimbabwe papers, SADCC journals and international technology papers. These have spoken of the event's success and look forward to its reappearance in 1984.

The RDT cinema

Nearly fifty films about rural development in countries all over the world were on show continuously throughout the exhibition in the specially-designated hall within the Showground. The films proved very popular – there were seldom less than 40 people watching.

Topics included health care, hygiene, food production, crop processing, women's rights, case histories of small villages, wildlife management and conservation.

Amongst those who lent films were UN Information Centre, UNICEF, Shell, Tropical Products Institute, British Council, IDRC (Canada), Zimbabwe Natural Resources Board and The Zimbabwe Trust whose new film "Swords into Ploughshares" was particularly popular. The Zimbabwe Information Ministry not only provided the projector and an indefatigable operator but also sent their own film team to make a film of the exhibition.

ZIIE

The organisers of RDT are Zimbabwe International Industrial Trade Exhibitions (Pvt) Ltd part of the internationally-based Andry Montgomery Group who act as managing agents. ZIIE is located in Harare. Tendai Dumbutshena is the manager and it is to him that enquiries should be made about future ZIIE projects. If, however, you are outside Africa, please contact either Jimmy Skinner or Ian Grimshaw at the London office.

Further details of RDT82, the RDT conference and RDT84, please contact:

ZIIE (Pvt) Ltd
P O Box 4259
Harare
Zimbabwe
Tel: 793206
Tlx: 4666 PCO
(mark attn. P O Box 4259)

ZIIE (Pvt) Ltd
11 Manchester Square
London W1M 5AB
UK
Tel: 01-486 1951
Tlx: 24591 Montex G

FAO's special message to RDT

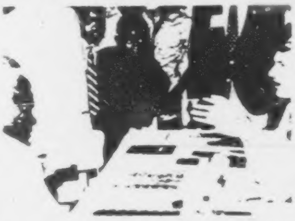
The Director General of the UN's Food and Agricultural Organisation, Mr Edouard Saouma, sent a special message to exhibitors and visitors to RDT82 welcoming the 'many types of technology and equipment on display which can be used to increase agricultural production and improve the efficiency of the energy used in agriculture'. He also expressed his hope that FAO's exhibit and its participation in some of the seminars would contribute to the success of the exhibition. The FAO stand proved a popular attraction as did the seminars. Together they gave some fascinating glimpses of the varied and important work in food production carried out worldwide by this UN agency.

American successes

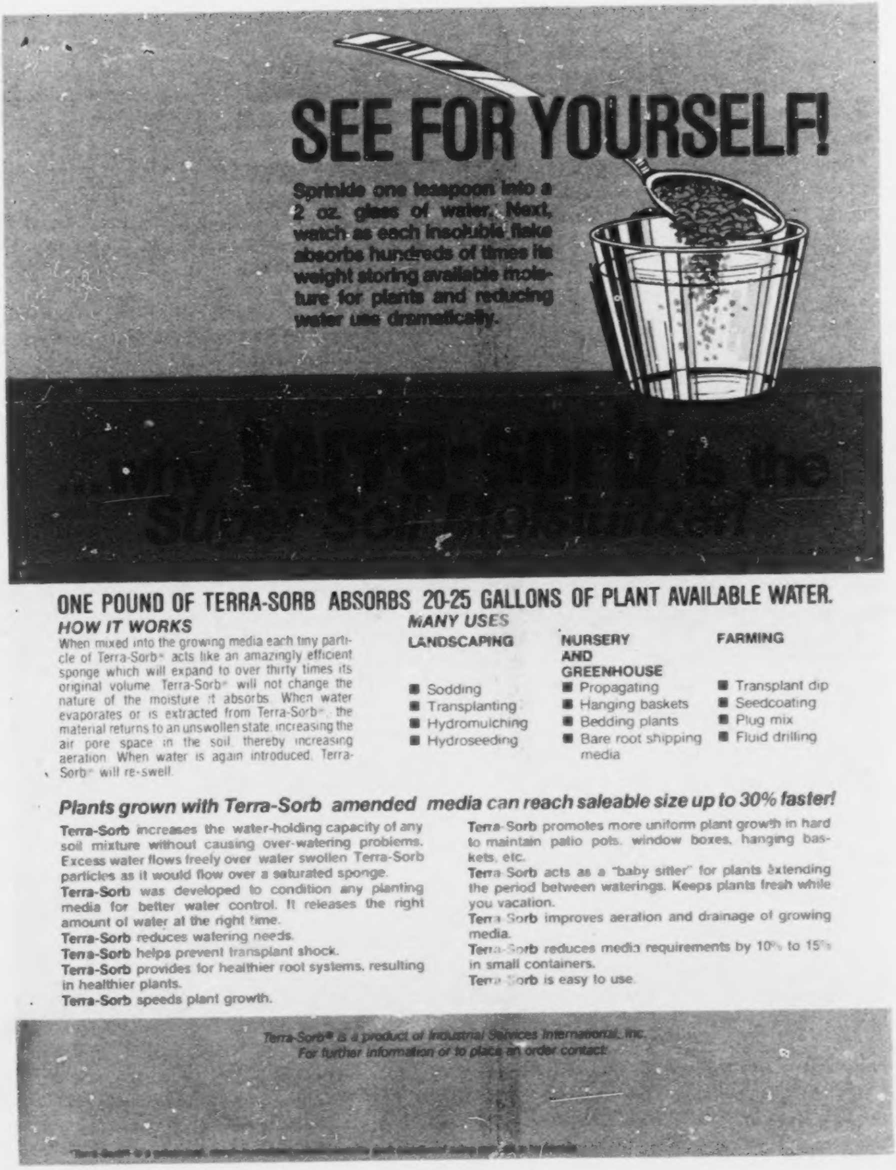
Strong support by USAID resulted in the US stand being the largest in the main hall at the Showgrounds with some forty companies and organisations represented. The US exhibitors were delighted by their achievements and most of them changed their travel plans to allow them to stay longer in the country to follow up their deals.

Among the US successes, was the initiation of licensing agreements with firms from Southern Africa in general and Botswana and Zimbabwe in particular, to manufacture windmills, handlooms and solar panels. A project agreement was also signed with Botswana to train 12 students on solar panels with funds being provided from the US Government.

American exhibitors were overwhelmed by the interest shown in their products and processes which promised to lead to numerous sales as well as to joint ventures, licensing and agency agreements.



Seen here is one of those highly-successful participants, Richard Komp of Sunwatt showing his photovoltaic panels to Mr Joshua Nkomo MP, one of the show's distinguished visitors.



SEE FOR YOURSELF!

Sprinkle one teaspoon into a 2 oz. glass of water. Next, watch as each insoluble flake absorbs hundreds of times its weight storing available moisture for plants and reducing water use dramatically.

…Why Terra-Sorb is the Super Soil Moisturizer!

ONE POUND OF TERRA-SORB ABSORBS 20-25 GALLONS OF PLANT AVAILABLE WATER.

HOW IT WORKS

When mixed into the growing media each tiny particle of Terra-Sorb® acts like an amazingly efficient sponge which will expand to over thirty times its original volume. Terra-Sorb® will not change the nature of the moisture it absorbs. When water evaporates or is extracted from Terra-Sorb®, the material returns to an unswollen state, increasing the air pore space in the soil, thereby increasing aeration. When water is again introduced, Terra-Sorb® will re-swell.

MANY USES

LANDSCAPING	NURSERY AND GREENHOUSE	FARMING
■ Sodding	■ Propagating	■ Transplant dip
■ Transplanting	■ Hanging baskets	■ Seedcoating
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Plants grown with Terra-Sorb amended media can reach saleable size up to 30% faster!

Terra-Sorb increases the water-holding capacity of any soil mixture without causing over-watering problems. Excess water flows freely over water swollen Terra-Sorb particles as it would flow over a saturated sponge.

Terra-Sorb was developed to condition any planting media for better water control. It releases the right amount of water at the right time.

Terra-Sorb reduces watering needs.

Terra-Sorb helps prevent transplant shock.

Terra-Sorb provides for healthier root systems, resulting in healthier plants.

Terra-Sorb speeds plant growth.

Terra-Sorb promotes more uniform plant growth in hard to maintain patio pots, window boxes, hanging baskets, etc.

Terra-Sorb acts as a "baby sitter" for plants extending the period between waterings. Keeps plants fresh while you vacation.

Terra-Sorb improves aeration and drainage of growing media.

Terra-Sorb reduces media requirements by 10% to 15% in small containers.

Terra-Sorb is easy to use.

Terra-Sorb® is a product of Industrial Services International, Inc.
For further information or to place an order contact:

[illegible]

APPENDIX B.—CORRESPONDENCE BETWEEN CHAIRMAN BEDELL AND NASA

EXHIBIT 1

COMMITTEE ON SMALL BUSINESS,
Washington, D.C., December 21, 1982.

Hon. JAMES M. BEGGS,
Administrator, NASA,
Washington, D.C.

DEAR MR. BEGGS: The House Small Business Committee on Energy, which I chair, recently held hearings on Marketing Opportunities in the Photovoltaics Industry. One of our witnesses at that hearing testified that his company had been treated unfairly in the photovoltaic refrigeration project being administered by personnel at NASA's Lewis Research Center in Cleveland, Ohio.

The Energy Subcommittee had previously received similar complaints from another small company participating in the PV refrigeration project administered by NASA. The Subcommittee's staff has met with NASA officials in Washington to discuss the details of the prime contract awards and I have personally discussed the project with Dr. Stuart Fordyce of NASA's Lewis Research Center.

I have serious reservations about the manner in which NASA has handled the prime contract awards for the PV refrigeration project. It is apparent to me that the evaluation process used by NASA was cynically biased against the participation of small companies as prime contractors in the PV refrigeration project.

It is my understanding that NASA is in the process of evaluating proposals for a PV refrigeration demonstration project in Gabon (RFP-3-409510, July 28, 1982). In light of what we know about the previous prime contract awards in NASA's refrigeration projects, I respectfully request that final consideration of awards for the Gabon project be deferred until the Small Business Committee has had time to investigate further and thoroughly review NASA's commitment to providing an equitable opportunity for small businesses to demonstrate their proficiency in the important area of photovoltaic equipment technology.

If you have any questions or need further information concerning this matter, contact Mark Levine or Marc Rosenberg on the Subcommittee's staff, at (202) 225-8944.

Sincerely,

BERKLEY BEDELL, *Chairman.*

EXHIBIT 2

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
Washington, D.C., January 13, 1983.

Hon. BERKLEY BEDELL,
Chairman, Subcommittee on Energy, Environment, and Safety Issues Affecting Small Business, Committee on Small Business, House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: This responds to your November 18, 1982, inquiry regarding the NASA Lewis Research Center's procurement for solar photovoltaic-powered refrigerator/freezer. You also expressed an interest on behalf of Mr. Arthur D. Sams, Vice President of Polar Products, regarding NASA Lewis Research Center's Request for Proposal 3-136300 for ten solar photovoltaic-powered refrigerator/freezer systems. Mr. Sams questions the planned contract award of this procurement on a noncompetitive basis to Solavolt International, Phoenix, Arizona.

We have conducted a detailed review of this matter and regret that this has delayed our response to you. In the enclosure we are providing information on the purpose, agency participation, and overall procurement approach used for the photovoltaic-powered refrigerator evaluation project at Lewis, as well as a discussion of the particular procurement of interest to Mr. Sams.

Similar information is being provided to Senators Alan Cranston and Henry M. Jackson, and Congressmen Al Swift and Anthony C. Beilenson, who also inquired into the matter on behalf of Mr. Sams.

Please let us know when we may be of further assistance to you.

Sincerely,

JOHN F. MURPHY,
Assistant Administrator for Legislative Affairs.

Enclosure.

NASA LEWIS RESEARCH CENTER PROCUREMENT FOR SOLAR PHOTOVOLTAIC-POWERED REFRIGERATOR/FREEZER FOR MEDICAL USE IN REMOTE GEOGRAPHIC LOCATIONS

The objective of this project is to determine the suitability of photovoltaic refrigerator/freezer systems in terms of cost and reliability for vaccine preservation in rural areas of developing countries and to establish qualified sources in the United States for future replication. To accomplish this objective, model systems were to be developed and qualified. After qualification, replication systems were to be acquired and performance tested at various foreign sites. The Centers for Disease Control, rather than the United States Agency for International Development (USAID), as indicated by Mr. Sams, initiated this project. NASA's Lewis Research Center, however, was requested to provide technical and procurement management for the project, with funding coming from three sources: the Department of Energy for the development and qualification portion of the effort, and the Agency for International Development and Centers for Disease Control for the replication systems. Contract obligations for this project have been approximately $600,000.

Consistent with the objective of the project, the Lewis Research Center issued competitively, on August 21, 1980, Request for Proposal 3-142887 entitled, "Solar Photovoltaic Powered Refrigerator/Freezer for Medical Use in Remote Geographic Locations." Small businesses were actively solicited, with some 20 of the 40 firms receiving the request for proposal classified as small. Regarding the request for proposal provisions, the solicitation was issued as a research and development procurement, inasmuch as market searches indicated that photovoltaic-powered refrigeration systems meeting the Centers for Disease Control requirements were not available off-the-shelf. The solicitation advised offerors that multiple contract awards on a cost-plus-fixed-fee basis were contemplated. In addition to the design, fabrication, and test of a qualification system, the solicitation identified the 10–50 replication systems as an option to be negotiated upon successful development and qualification of the initial system. In view of the system requirements, the request for proposal suggested that an offeror with refrigeration expertise consider teaming with a photovoltaic manufacturer, or vice versa. The procurement did not, however, require any installation and training as indicated by Mr. Sams; we believe this to be a reference to Solavolt's performance on a private contract with Mr. Sams' firm.

Seven proposals were received on October 6, 1980, and were evaluated in accordance with the technical, cost, experience and past performance, and other factors specified in the request for proposal. Based on this evaluation, three proposals were considered outside the competitive range, that is, not having a reasonable chance of being selected for award. Of these proposals, one was from Proko International, the predecessor to Mr. Sams' present company, Polar Products. The evaluation findings relative to the Proko proposal, including technical proposal weaknesses, were discussed with Mr. Sams in a January 29, 1981, debriefing. Relative to Mr. Sams' reference to being the lowest bidder on this procurement, we confirmed that the Proko proposal offered costs that were lower than two of the three firms subsequently awarded contracts.

The other four offerors, each proposing a different design concept, were selected for negotiation of a contract. Three of these firms, ARCO Solar Inc., Solar Power Corporation, and Motorola, Inc., (teaming jointly with Western Solar Refrigeration, Inc., a small business) were awarded contracts for system fabrication and qualification testing. The contracts also included the options to negotiate replication systems. The fourth offeror selected for negotiation was Applied Solar Energy Corporation, which proposed a subcontract with Proko International. Applied Solar Energy, however, requested withdrawal of its proposal prior to contract award, stating that the withdrawal was a result of a reorganization of the firm.

The three development contracts initiated by this procurement have now been completed (or terminated). The contract with ARCO Solar was terminated on September 16, 1981, at the request of the contractor, because of technical difficulties encountered. The Solar Power Corporation photovoltaic-powered refrigerator/freezer system successfully passed acceptance testing during the week of June 22, 1981, and the firm has since been awarded a contract on a noncompetitive basis to deploy 19 replication systems as contemplated under the option provision of the development procurement. Eleven of these systems have already been installed, with the remaining eight to be installed during the first quarter of 1983.

With respect to the third contract, Motorola was initially unable to qualify its proposed Western Solar refrigerator/freezer unit. As a result of this technical problem, Motorola contacted a second source for the refrigerator/freezer unit, Proko International (now Polar Products). The Proko unit and ultimately the Western Solar unit successfully passed qualification testing on December 19, 1981, and acceptance testing on January 20, 1982.

In view of the successful qualification tests, Lewis exercised the option in the development contract with Motorola by issuing, on a noncompetitive basis, Request for Proposal 3-136300. This procurement was for ten replication systems for site testing, as contemplated by both the original planning for this project and the earlier request for proposal. Solavolt International submitted a proposal on April 30, 1982, for ths effort, stating that Motorola's Solar Energy Division had entered into a joint venture agreement with Shell Energy System to form Solavolt. Solavolt proposed five photovoltaic systems with refrigerator/freezer units form Western Solar (now Marvel) and five with refrigerator/freezer units from Polar Products.

Although Mr. Sams stated in his letter that virtually all of the work, exclusive of field installation and training, is to be subcontracted to his firm, our review indicated that the solar photovoltaic effort and systems integration are significant portions of the requirement and that only approximately one-third of the effort and one-fourth of the costs are associated with the proposed refrigerator/freezer subcontract to Polar Products.

The technical evaluation of the Solavolt proposal, completed July 1, 1982, indicated major differences in the interpretation of the scope of work for this procurement and at NASA's request, Solavolt submitted a revised proposal on September 27, 1982. In reviewing this latter submission, further clarification of the Statement of Work appeared necessary. It was also learned at this time that Solavolt was encountering substantial problems in negotiating a subcontract with Mr. Sams' firm. Apart from these circumstances, our investigation disclosed no Agency interference with Polar Products' marketing or any exclusive arrangement with Solavolt or other oil-related solar companies. Also, it is our understanding that companies associated with the solar photovoltaic refrigerator market, including all of those identified in Mr. Sams' letter, are stocking, advertising, and delivering these systems, contrary to Mr. Sams' views.

On November 17, 1982, Mr. Sams, representatives from Solavolt, and NASA personnel discussed the technical requirements for this procurement in order to resolve any remaining differences concerning scope or interpretation. As a consequence of this meeting, Solavolt submitted on December 1, a revised technical and cost proposal, including the proposed subcontract effort to Mr. Sams' firm. This proposal is presently being evaluated, with negotiations and contract award anticipated in January 1983.

With respect to Mr. Sams' statement that he has written numerous letters to NASA over the years without a direct reply, our review disclosed resposes to all identified procurement correspondence. It is accurate, however, that letters sent to NASA technical personnel have not been answered during the evaluation of competitive procurements. This is an Agency practice in order to maintain the integrity of the procurement process.

Our overall consideration of this matter indicates that the procurement to Solavolt was in conformance with the project objectives and was the most effective approach for providing replication systems for field testing. Our review also indicates that the procedures followed by the Lewis Research Center for this project were in accordance with NASA policy and regulations, both with respect to the procurement procedures used and also in affording small business the opportunity to participate.

EXHIBIT 3

National Aeronautics and Space Administration,
Washington, D.C., January 26, 1983.

Hon. Berkley Bedell,
Chairman, Subcommittee on Energy, Environment and Safety Issues Affecting Small Business, Committee on Small Business, House of Representatives, Washington, D.C.

Dear Mr. Chairman: This responds to your December 21, 1982, letter questioning NASA's commitment to provide an equitable opportunity for small business to participate in the area of photovoltaic (PV) equipment technology. Specifically, your letter addressed two principle concerns, namely the manner in which NASA is handling a pending contract award for the PV powered vaccine refrigerator project that NASA is managing for the Centers for Disease Control and other Federal agencies; and, how NASA is handling the competitive procurement process for a solar power demonstration program in the Republic of Gabon.

Your first concern, regarding the pending contract award to Solavolt International, which is a part of the PV refrigerator project, was originally raised by Mr. Marc Rosenberg of your staff, in a letter to NASA dated November 18, 1982. Our response dated January 13, 1983, provided a detailed description of the facts surrounding this procurement. In summary, our overall consideration of this matter indicated that the procurement to Solavolt was in conformance with the project objectives and was the most effective approach for providing replication systems for field testing. Our review also indicates that the procedures followed by the Lewis Research Center for this project were in accordance with NASA policy and regulations, both with respect to the procurement procedures used and also in affording small business the opportunity to participate.

In response to your second concern regarding NASA's handling of a current competitive procurement for a joint program of demonstration of solar PV power in the Republic of Gabon, NASA is now in the process of evaluating proposals in response to RFP-3-409510 of July 28, 1982, for the Design, Development, and Deployment of Public Service Photovoltaic Power/Load Systems for the Gabonese Republic. This project is funded by the Department of Energy (DOE) and the Republic of Gabon. United States project management responsibility has been assigned to NASA's Lewis Research Center. Your letter of December 21, 1982, states that it is your understanding that NASA is in the process of evaluating proposals for a PV refrigerator project in Gabon. In fact, the goal of the program is to demonstrate the technical, economic, and social value of PV power systems by assisting development and by improving the quality of life in rural areas of Gabon. The contract, to be awarded to a U.S. firm, will provide for the design, fabrication, shipping, installation, and monitoring of four village PV power systems to meet the requirement of four public services, namely: (1) health (lighting, ventilation, and refrigeration); (2) education (lighting and audio-visual teaching equipment); (3) water supply (water pump, storage and distribution system); and (4) area lighting (outdoor pole lighting).

By the way of background, DOE has funded a PV Stand-Alone Application Project, under which NASA's Lewis Research Center was given the responsibility for implementing cost-shared demonstration projects with potential users to facilitate the commercialization of PV systems, both domestically and overseas. The Gabon PV project was initiated at the request of the Gabonese officials in later 1979 and consists of $1,600,000 of which $600,000 will cover the drilling of wells, and services within Gabon. This amount will be borne entirely by the Republic of Gabon. DOE is providing $500,000 for the project, and the Republic of Gabon is providing $500,000. This total of $1,000,000 is the estimated value of the contract to be awarded to a U.S. firm.

A memorandum of understanding (MOU) between the Republic of Gabon and the DOE was signed on February 6, 1982, outlining the roles and responsibilities of NASA's Lewis Research Center including:

(1) Conducting site visits;

(2) Preparing conceptual designs and specifications;

(3) Awarding a contract for design, fabrication, checkout, and installation and monitoring of four village systems;

(4) Training and disseminating information to Gabonese personnel;

(5) Supporting Gabonese personnel in the evaluation of the project;

(6) Carrying out the program in accordance with the Implementation Plan (IP) attached to the MOU.

The Implementation Plan (IP) is being prepared for final signature by the Gabonese. The plan, which covers all aspects of the project including the procurement of the village systems, is the result of extensive detailed negotiations between the Gabonese and NASA officials. It was determined that an unrestricted, cost-shared procurement would be appropriate to implement this work. The IP states that "Lewis will award a contract to a U.S. engineering firm for the design, fabrication, testing, shipping, installation and checkout, monitoring and maintenance of the village energy demonstration systems. The contract will be competitively awarded according to the NASA Procurement Regulation."

The procurement package was reviewed by the NASA Lewis Research Center Small Business Specialist, and a representative of the U.S. Small Business Administration. Both agreed that, because of the nature and magnitude of the proposed effort, competition should be maximized. The RFP was issued on July 28, 1982, to 102 firms of which at least 30 identified themselves as small. Technical and Business proposals were due by October 4, 1982. Proposals were received from seven firms of which three are small. Proposals are now in the evaluation process.

Our overall review of this matter indicates that the RFP is consistent with procurement arrangements negotiated with the Gabonese, and that small firms were given an equal opportunity to bid on the project and are currently under active consideration for award. There are no restrictive specifications or clauses which would inhibit small businesses from proposing. In addition, the RFP requires all offerors, who are not small businesses, to submit with their proposal a plan for subcontracting with small and small disadvantaged firms. The plan will be considered in NASA's source evaluation and selection process.

If a large business is selected to perform the prime contract, the following provision, included in the RFP, will become effective:

The apparent successful offeror will negotiate a complete subcontracting plan which provides the maximum practicable opportunity (including percentage goals) for subcontracting with small business concerns, and small disadvantaged business concerns. No contract will be awarded unless and until an acceptable plan is negotiated with the contracting officer. The plan will be incorporated into the contract, as a material part thereof.

Based on our review and the circumstances described above, we find no reason to delay the selection process and intend to proceed with the procurement.

We trust this information will be helpful to you. If you require anything else please let us know.

Sincerely,

JOHN F. MURPHY,
Assistant Administrator for Legislative Affairs.

EXHIBIT 4

COMMITTEE ON SMALL BUSINESS,
Washington, D.C., February 2, 1983.

Hon. JAMES M. BEGGS,
Administrator, NASA,
Washington, D.C.

DEAR MR. BEGGS: On December 21, 1982, I wrote to you expressing my concern that small businesses had been treated unfairly in NASA's handling of procurements of high efficiency refrigeration systems. On January 26, 1983 I received a reply letter from Mr. John F. Murphy, NASA's Assistant Administrator of Legislative Affairs. Mr. Murphy's response left many questions unanswered.

Consequently, I am asking NASA's Inspector General to review my concerns. A copy is enclosed, for your information. Please note that I am again requesting that further action on a related NASA procurement, (RFP-3-409510 July 28, 1982), be delayed until the Small Business Subcommittee on General Oversight, which I now chair, and NASA's Inspector General, have thoroughly reviewed NASA's actions in these procurements. I am confident that you will share my feeling that this procurement action should not proceed until all concerns have been satisfactorily resolved.

Sincerely,

BERKLEY BEDELL.

EXHIBIT 5

COMMITTEE ON SMALL BUSINESS,
Washington, D.C., February 2, 1983.

Mrs. JUNE BROWN,
Inspector General, NASA,
Washington, D.C.

DEAR MRS. BROWN: The Energy Subcommittee of the House Small Business Committee has been reviewing allegations that small business concerns have been discriminated against in NASA's handling of a series of procurements relating to the development and testing of photovoltaic vaccine refrigeration systems.[1] In part, these charges were aired at a hearing of the Subcommittee on Energy and the Environment, which I chaired on December 9, 1982.

The Subcommittee has talked to and reviewed the files of two small businesses involved in the development and marketing of high efficiency refrigeration systems. We have also had extensive conversations at the staff level with NASA personnel involved in the contract awards. In addition, I have discussed the Subcommittee's concerns with NASA officials at the Lewis Research Center in Cleveland. To be frank about it, I am concerned that NASA's handling of these refrigeration procurements demonstrated at best questionable judgment.

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[1] Our concerns include, but are not limited to, the circumstances surrounding RFP #3-142887 and RFP3-136300.

Although practically all of the original research and development work on high efficiency refrigeration systems had been done by small businesses, and three small business concerns with proven track records with the type of systems NASA wanted did bid on the project, NASA instead awarded the contracts to large companies with little or no experience in high efficiency refrigeration systems. In fact, as unusual as it may seem, the prime contract award winners in the refrigeration procurements had such little experience and knowledge of the technology, they subcontracted to the small companies for much of the work required by the procurement.

We are concerned because of the complaints we have received from two of the small companies hired as subcontractors in the NASA procurements. These companies argue that by awarding the prime contracts to firms not previously involved in high-efficiency refrigeration systems, NASA in effect put their competitors in business. They also charge that because of poor performance by one of the prime contractors, their marketing opportunities have been severely limited. In fact, one of the subcontractors testified at our December hearing that his company was forced into Chapter 11 bankruptcy because of the way the procurements were managed by NASA and the prime contractor.

In this new session of the Congress, I am serving as chairman of the Small Business Subcommittee on General Oversight. In that capacity, I am requesting that your office initiate an immediate investigation of the procurement actions taken by NASA with regard to high efficiency refrigeration systems.

Specifically, I would like the original objectives of the procurements to be reviewed. Was NASA selecting a prime contractor merely to assemble and install off-the-shelf, commercially available products? Could the prime contract tasks desired by NASA have been performed by small businesses? Did the prime contractors selected by NASA have the necessary expertise in high-efficiency refrigeration systems required for the project? Did the contractors themselves, or any actions by NASA or a prime contractor in the procurement limit the marketing opportunities of small businesses in the high-efficiency refrigeration business?

In addition, at the Energy Subcommittee's December hearing on marketing opportunities in the photovoltaic industry, one of our witnesses stated that, "NASA-Lewis personnel strongly recommended to WSR that the company bid the contract jointly with Motorola, with Motorola acting as prime contractor." Is this a proper action for NASA personnel to take? Another small company told us that, based on his knowledge of the refrigeration industry, he believed NASA paid far too much for the procurement of these systems. I would like your office to examine the tasks to be performed and the sums accruing to the prime contractors in these procurements. I would be especially interested to see your analysis of how these compare with those proposed by the small companies who originally bid on the projects.

Now, in a related matter, it is my understanding that NASA is presently selecting a prime contractor for a joint program of demonstration of solar photovoltaics power in the Republic of Gabon (RFP-3-409510, July 28, 1982.) The project is being managed by NASA and funded by the Department of Energy. Many of the bidders on this contract are the same ones who were involved in the earlier refrigeration procurements. I have learned that prior to the issuance of the RFP for the Gabon project, NASA personnel met in Gabon with representatives of at least one and perhaps several of the large companies that are now bidding on the project. I would like your office to review the propriety of this action by NASA personnel. Also, I would like your determination of whether or not the companies whose agents met with NASA personnel in Gabon have received any advantages over those firms which did not have this opportunity.

Finally, because of the many questions concerning NASA's handling of the high efficiency refrigeration procurements, and the questions we have concerning the awarding of the Gabon project, I respectfully request that further consideration of proposals and contractor selections on the Gabon project be deferred until your office and the Small Business Committee have had time to investigate further and thoroughly review NASA's commitment to providing an equitable opportunity for small businesses to demonstrate their proficiency in the important area of photovoltaic equipment technology.

Given our firm belief that the Gabon project should not proceed until these questions are satisfactorily resolved, I am sure you will share our desire for a quick response to those questions. If you need any further information from us regarding this request, please contact Mark Levine of the subcommittee staff at 225-8944.

Sincerely,

BERKLEY BEDELL.

APPENDIX C.—CORRESPONDENCE BETWEEN CHAIRMAN BEDELL AND DOE

EXHIBIT 1

COMMITTEE ON SMALL BUSINESS,
Washington, D.C., January 24, 1983.

Mr. JOSEPH J. TRIBBLE,
Assistant Secretary for Conservation and Renewable Energy, Department of Energy, Washington, D.C.

DEAR MR. TRIBBLE: The Energy Subcommittee appreciates the testimony you gave at our Dec. 9, 1982 hearing on marketing opportunities in the photovoltaics industry. As chairman, I especially appreciate that you made time on your schedule to sit through the entire hearing. As I told you during the hearing, it is refreshing that someone in your position takes the time to listen to what others have to say at a Congressional hearing. We see far too little of that on Capitol Hill.

The purpose of this letter is to seek further information about some of the subjects we touched upon during the hearing. Because of time constraints, we were not able to pursue some of these points as thoroughly as we would have liked. To supplement our hearing record, then, I invite your responses to the following questions:

(1) In your prepared statement you said that, "The transition of renewable technologies, including PV, from R&D to commercialization is also being facilitated through Federal tax policy. . . . For example, photovoltaic systems are currently eligible for the 40-percent residential energy credit and a 15-percent business investment tax credit enacted in the Windfall Profit Tax Act of 1980."

As you are aware, on more than one occasion the Reagan Administration has proposed eliminating the residential and business energy tax credit. Does your statement to the Subcommittee mean the Department of Energy supports the tax credit?

(2) One of our other witnesses felt that, because of its reduced funding levels, the DOE photovoltaic research and development program could best be leveraged by assuring that private companies had sufficient access to the program's funds. Could you provide us with figures that separately chart the flow of funds in the DOE PV program through national labs (i.e., JPL, Sandia, etc.), universities, small business and large business for program years 1979 through 1983?

(3) You mentioned during the hearing that DOE was intent on removing program support in areas where private industry was investing its own research funds. Does DOE have a mechanism for determining how much money and in what areas of PV research private industry is investing? If DOE does have this information, could you share it with the Subcommittee? If proprietary data is a problem in meeting this request, we would accept aggregated information.

(4) Several witnesses felt that it would be quite some time before any companies involved in photovoltaics would earn profits from their PV operations. If this is so, and we also consider the substantial cutbacks in funding for DOE's PV program, what place do you see for small businesses in the future of the PV industry?

(5) As you are aware, I have been very concerned about DOE's policy of restricting informational displays by laboratories about their PV work done under DOE contract. I recall the Solar Panel of DOE's Energy Research Advisory Board told Secretary Edwards in last year's report that, "Research that goes undocumented might just as well never be performed."

Do you support the new restrictions on information dissemination? Do you anticipate any change in this policy now that there is a Secretary of Energy?

Mr. Tribble, I want to thank you again for your testimony on Dec. 9. We would appreciate a response to this letter by mid-February, to meet publication deadlines for our hearing record. If you or your staff have any questions concerning this request, please contact Mark Levine of the Subcommittee staff at 225-8944.

Sincerely,

BERKLEY BEDELL, *Chairman.*

EXHIBIT 2

DEPARTMENT OF ENERGY,
Washington, D.C., February 22, 1983.

Hon. BERKLEY BEDELL,
Chairman, Subcommittee on Energy, Environment and Safety Issues Affecting Small Business, House of Representatives, Washington, D.C.

DEAR MR. CHAIRMAN: Following the December 9, 1982, hearing on marketing opportunities in the photovoltaics industry, you requested information to supplement the official hearing record from Assistant Secretary Joseph Tribble. Information for the hearing record is enclosed.

If you have any questions, please call Ingrid Nelson or Tom Pretorius of my staff on 252-4277. They will be happy to assist you.

Sincerely,

THOMAS H. PRETORIUS,
(For Robert G. Rabben,
Assistant General Counsel for Legislation).

Enclosures.

Question 1: In your prepared statement, you said that, The transition of renewable technologies, including PV, from R&D to commercialization is also being facilitated through Federal tax policy... For example, photovoltaic systems are currently eligible for the 40% residential energy credit and a 15% business investment tax credit enacted in the Windfall Profits Tax Act of 1980."

As you are aware, on more than one occasion, the Reagan Administration has proposed eliminating the residential and business tax credit. Does your statement to the Subcommittee mean that the Department of Energy supports the tax credit?

Answer: I understand, the Administration is proposing no changes to the current residential and business energy tax credits at this time. We support this position.

QUESTION 2: One of our other witnesses felt that, because of its reduced funding levels, the DOE photovoltaic research and development program could best be leveraged by assuring that private companies had sufficient access to the program's funds. Could you provide us with figures that separately chart the flow of funds in the DOE PV program through national labs (i.e., JPL, Sandia, etc.), universities, small business and large business for program years 1979 through 1983?

ANSWER: The photovoltaic program allocates its funds evenly between three laboratories, SERI, JPL and Sandia. Using these funds and an annual plan approved by DOE, the laboratories conduct research using both contractors and in-house laboratory personnel. The following provides a percentage split of subcontract dollars at each laboratory for the years 1979-1982. FY 1983 data is not yet available.

	FY 1979	FY 1980	FY 1981	FY 1982
JPL				
Small Bus.	21%	26%	23%	27%
Large Bus.	72%	66%	69%	63%
University	4%	3%	4%	8%
Other	3%	5%	4%	2%
Total	100%	100%	100%	100%
Sandia				
Small Bus.	21%	32%	28%	17%
Large Bus.	69%	57%	55%	56%
University	5%	5%	6%	11%
Other	5%	6%	11%	16%
Total	100%	100%	100%	100%
SERI				
Small Bus.	15%	14%	14%	7%
Large Bus.	42%	42%	36%	38%
University	22%	24%	31%	38%
Other	21%	20%	19%	17%
Total	100%	100%	100%	100%

QUESTION 3: You mentioned during the hearing that DOE was intent on removing program support in areas where private industry was investing its own research funds. Does DOE have a mechanism for determining how much money and in what areas of PV research private industry is investing? If DOE does have this information, could you share it with the Subcommittee? If proprietary data is a problem in meeting this request, we would accept aggregated information.

ANSWER: DOE determines how much money and in what areas of PV research private industry is investing essentially through two mechanisms, public announcements made in the press and at national and international technical conferences and through personal direct discussions between members of the DOE program and members of private companies. The later mechanism is particularly effective because it is based on long standing associations and friendships within the PV scientific community. Based on this we find that the following companies have been investing heavily in PV research.

Companies	Technology
1. Joint venture between Bates and Reading and Boeing	Thin film copper indium diselenide
2. SOHIO, Energy Conversion Devices	Thin film amorphous silicon
3. Texas Instruments	Silicon beads with hydrogen storage/fuel cell
4. RCA	Thin film amorphous
5. ARCO Solar	Silicon ribbon and amorphous silicon
6. Mobile Solar Energy	Silicon ribbon
7. Westinghouse	Silicon ribbon
8. Ametek	Thin film-cadmium telluride
9. Eastman Kodak	Thin film-cadmium telluride

We believe the nine companies mentioned above invested approximately $45 million in the past 12-18 months. In addition another $10 million was invested by a large group of other companies.

QUESTION 4: Several witnesses felt that it would be quite some time before any companies involved in photovoltaics would earn profits from their PV operations. If this is so, and we also consider the substantial cutbacks in funding for DOE's PV program, what place do you see for small businesses in the future of PV industry?

ANSWER: Small businesses, along with Universities, have in the past been major contributors to the advancement of the PV program. In recognition of this fact, the DOE PV program will continue to support research conducted by small business, as future funding allows. In addition, PV was selected as one of the topics for the Department's first Small Business Innovation Research Program Solicitation, under P.L.-97-219, for which proposals are due March 1, with awards expected this summer. Venture capital and stock offerings are other sources of funds for innovative small businesses. Several firms have been successful in attracting funds in this manner in the past (e.g. Energy Conversion Devices, Inc., Spire Corp.).

While the economies of scale inherent in PV production may limit small business participation in actual manufacture, several PV industry activities such as design, installation, maintenance and repair of PV systems can be considered excellent opportunities for small businesses.

QUESTION 5: As you are aware, I have been very concerned about DOE's policy of restricting informational displays by laboratories about their PV work done under DOE contract. I recall the Solar Panel of DOE's Energy Research Advisory Board told Secretary Edwards in last year's report that, "Research that goes undocumented might just as well never been performed."

Do you support the new restrictions on information dissemination? Do you anticipate any change in this policy now that there is a Secretary of Energy?

ANSWER: We agree completely with the comment you referenced from the Solar Panel of DOE's Energy Research Advisory Board. Documentation and information transfer in the Photovoltaic Program take place thru:

(1) Quarterly and Annual Contract Reports

(2) Annual PV Program Meetings (most recent meeting was held in Crystal City, Virginia on February 15-16, 1983)

(3) Papers given at professional meetings

(4) Special technical workshops

(5) Program Integration Meetings

While informational displays add to the information transfer process, they are by no means critical. By presenting technical papers, participating in panels and acting as session chairman, DOE researchers provide for a much more effective means of transferring knowledge from laboratory research to industry practice. An example of this interchange occurred at a recent four day IEEE meeting. DOE photovoltaic laboratory personnel made 44 technical presentations and participated in 28 other sessions as advisors.

APPENDIX D.—CORRESPONDENCE BETWEEN CHAIRMAN BEDELL AND AID

EXHIBIT 1

COMMITTEE ON SMALL BUSINESS,
Washington, D.C., December 22, 1982.

Hon. PETER MCPHERSON,
Administrator, Agency for International Development,
Washington, D.C.

DEAR MR. MCPHERSON: The House Small Business Energy Subcommittee recently held a hearing on Marketing Opportunities in the Photovoltaics Industry. Two of the witnesses at that hearing participated in the U.S. pavilion at the Rural Development Technology Fair in Zimbabwe in September 1982. These witnesses testified that the fair was an extremely useful and productive first step in introducing U.S. small businesses to developing country markets. The U.S. participation in the Zimbabwe fair was supported in large part by AID.

The Energy Subcommittee and my personal office had previously heard from other small companies that attended or were represented at the Zimbabwe fair. I must say that the enthusiasm with which these small businesses related their experiences in Zimbabwe raised my interest in the technology fair concept.

In addition to being a productive exercise for the technology fair participants, these fairs obviously can play an important development role in fulfilling AID's mission. This was underscored in a memo written by AID's project manager after the Zimbabwe fair. His initial review for AID dated October 26, 1982, says:

"AID's participation in this exhibition recognized the role of trade in development. It is a fact that, as far as private sector activity is concerned, trade activity and prospective trade are key to job creation and foreign exchange earnings, and that investment generally follows where trade opportunities are discerned. Taiwan, Singapore and Korea are prime examples of this. Investment does not create foreign exchange until investment brings about export—which are, or course, the result of trade linkages. To the extent such trade linkages are between small and medium sized firms, the leverage for job creation and foreign exchange earnings is significant. This is true even in an industrialized nation, and is, in fact, the fundamental factor which argues for AID promotion of trade related activities in the developing countries."

Mr. McPherson, it is apparent that enthusiasm for technology trade fairs is not shared by everyone at AID. I am enclosing with this letter a copy of a memorandum from Mr. Stanley B. Scheinman of AID's Bureau of Private Enterprise that expresses his disapproval of the Zimbabwe fair and of AID's participation in any future technology fairs. This is particularly disturbing to me because it would seem that participation by Mr. Scheinman's office is essential to coordinating AID's involvement in future fairs.

I am also disturbed by testimony our Subcommittee received from AID witnesses at our hearing on December 9. We were told by Ms. Barbara Otis, the director of business relations in the Bureau of Private Investment, that an evaluation of the worthiness of the Zimbabwe fair would take "eight months, perhaps a little longer." She went on to say that AID would not agree to participate in other similar technology fairs until such time as the Agency has completed its review of the Zimbabwe show. This lengthy period is clearly unacceptable, especially considering the interest that has been expressed regarding AID's participation in a similar fair in Manila in 1983.

Mr. McPherson, we would like to know what role Mr. Scheinman and his office played in AID's efforts at the Zimbabwe fair. Is his office's participation or cooperation necessary in future technology fairs? Is his memorandum of September 21, 1982, the final word on AID's participation in the Manila fair?

If the question on AID's participation in the Manila fair is still open, the Subcommittee would like to know how much lead time is needed to coordinated the fair's activities and ensure maximum opportunity for U.S. small businesses to participate? Will AID's evaluation of the Zimbabwe fair be completed within this time frame, or could the evaluation be waived if time constraints dictate?

Taking a broader view, I am personally interested in the concept of technology fairs that display the appropriated technologies of U.S. small companies in developing countries. I feel that in addition to the obvious benefits to the U.S. economy, this concept can prove to be a powerful tool in our effort to maintain and improve our relations with developing countries. Perhaps we can arrange to meet in the near future to discuss AID's role in this vital area.

If you have any questions or need further information concerning our requests, contact Mark Levine of the Energy Subcommittee's staff at 225-8944.

Sincerely,

BERKLEY BEDELL, *Chairman.*

EXHIBIT 2

COMMITTEE ON SMALL BUSINESS,
Washington, D.C., January 3, 1983.

Hon. M. PETER MCPHERSON,
Administrator, Agency for International Development,
Washington, D.C. 20523

DEAR MR. MCPHERSON: I was recently contacted by a company that is headquartered in my district, Silopress, Inc. of Sioux City, Iowa, regarding their experiences at the Rural Development Technology Fair in Zimbabwe. The U.S. Agency for International Development coordinated the U.S. participation at the fair, which was held in September 1982. As you are aware, the fair was discussed extensively at a congressional hearing on December 9, which I chaired.

Enclosed with this letter is a copy of the correspondence I received from my constituent, expressing frustration at their inability to arrange financing under the Commodity Import Program credits given to Zimbabwe by AID. As their letter explains, a small amount of money ($30,000) is needed to finance the purchase of one of their machines by their Zimbabwean distributor for testing and demonstration purposes. This is the necessary next step in order for Silopress to enter what they perceive to be a very promising market for exports and joint ventures.

At this Subcommittee's December 9 hearing, one of the witnesses was a consultant who had attended the fair in Zimbabwe. He explained to us that because of problems with soft currency in developing nations the Commodity Import Program, which is administered by AID, is important to the success of new commercial ventures in those nations. He also told the Subcommittee that a lack of access to these CIP credits threatens to delay or even prevent the closing of several deals arranged by U.S. small businesses at the fair in Zimbabwe.

Mr. McPherson, I fully understand that by its nature the Commodity Import Program provides relatively limited opportunity for AID to intervene in host country purchase decisions. However, by the same token, there seems to be a legitimate concern among smaller companies that their limited access to AID-provided CIP credits may preclude the successful culmination of marketing efforts they undertook at the Zimbabwe technology fair.

Reflecting the Energy Subcommittee's continuing interest in the implementation of the technology fair concept by AID, we would like to obtain more information about the Commodity Import Program. Specifically, we are interested in learning what proposals, if any, AID is considering that would make commodity credits more readily available for the purchase of products displayed by U.S. small businesses at future technology fairs. As the enclosed letter from Silopress points out, the German, French and Japanese governments all appear to have developed ways to deal with the soft currency problems of developing nations. Has AID looked into what those governments do to resolve the currency problems that otherwise would affect their domestic firms' abilities to follow up on commercial leads obtained at these technology fairs?

In addition, and in a much more urgent time frame, we would like to know what actions AID has taken, or plans to take, to assist those U.S. small businesses who need access to commodity credits in order to fill sales orders stemming from their participation at the Zimbabwe fair. It would seem to be a great waste of everyone's time and effort for the U.S. government to encourage the participation of small companies at international fairs without assuring that basic problems like currency transfers can be resolved.

As you know, President Reagan has made private sector involvement a cornerstone of the administration's international economic development policy. AID's attempts to encourage small business participation at international technology fairs such as the one held recently in Zimbabwe certainly is consistent with that policy, as would be your participation in the fair to be held in Manila this year.

Our concern is that there may not be enough flexibility in the Commodity Import Program to fully accommodate the needs of the small companies attending these fairs in the future. This problem would seem to have a direct bearing on the success or failure of the President's proposal to increase private sector participation in international development, especially in the lesser-developed nations. I would welcome your comments on this problem in general as well as regards the specific concerns raised by my constituent.

Sincerely,

BERKLEY BEDELL, *Chairman.*

SILOPRESS

Silopress, Inc. USA
1915 Floyd Boulevard
Sioux City, Iowa 51104
Telephone: 712/255-4569

December 27, 1982

Representative Berkley Bedell
U.S. House of Representatives
Rayburn House Office Building
Washington, D.C. 20515

Dear Congressman Bedell:

Thank you for this opportunity to explain my company's existing problem concerning sales of our equipment to Zimbabwe, and to ask for your assistance in solving this problem.

You will recall that Silopress produces and sells a machine and system which compresses and stores large amounts of foodstuffs and silage in specially-made polyetheleyne bags for long periods of time. The system is inexpensive compared to traditional silo systems, is easy to maintain, extremely versatile, and has unlimited capacity. In reality it represents a technological breakthrough in the field of food storage for both animal and human consumption. Sales are going well in the United States despite the severe agricultural recession.

As you know, some months ago the company decided to undertake a worldwide marketing campaign. We are convinced that the system is needed and will be wanted in many parts of the world. And I would note that this effort by Silopress is directly in line with the U.S. Government's policy and encouragement to small and medium-sized firms to export, so as to assist the American economy and provide jobs for American workers--in our case many of these jobs would be created in the state of Iowa.

As part of our sales effort in Africa we decided--upon invitation from the Agency for International Development (AID)--to participate at our own expense in the U.S. pavillion at the international trade fair held in Bulawayo, Zimbabwe, last September. We devoted a considerable amount of resources to this--the Chairman of our company and two of our Vice Presidents attended as part of a seven-week marketing trip that they made through Africa and Europe.

Unfortunately Silopress and some of the other companies that participated have one problem resulting from the fair - inability to consummate sales because buyers of products and services have not yet been able to get allocations of foreign exchange from their Governments to pay us.

In our case, we found in Zimbabwe a solid local distributor for our product. The product is needed in Zimbabwe - it can help prevent starvation in that country. Our distributor has been and is prepared right now to purchase one of our machines for testing and demonstration purposes, preparatory to commencing a large-scale advertising and sales campaign. The company applied to the Zimbabwe Ministry of Commerce and Industry for the necessary import license and a modest allocation of AID Commodity Import Program (C.I.P.) funds, and supported this with good written statements from the pertinent local agricultural groups and organizations. The Zimbabwe Ministry of Agriculture also fully supported the company's application. To our surprise and dismay however, we recently were advised by our distributor that both the import license and the AID funds have been denied to the company - in fact the ministry claims that AID funds are "exhausted."

Frankly, this is difficult for us to comprehend. We believe that the machine can make a very important contribution to the improvement of Zimbabwe's agriculture, which is the country's number one economic priority. It will be wanted by farmers, owners of livestock, dairies, and the Ministry of Agriculture itself. Our distributor is prepared to buy one right now. AID has loaned or granted to the Government of Zimbabwe many millions of U. S. Dollars for the import of American products, especially agricultural machinery. Many more millions of Dollars are in process of being committed for the next several years. In fact, the U. S. is the Number One foreign financial donor to Zimbabwe. Large American companies are selling hundreds or thousands of tractors and other agricultural products to Zimbabwe, financed by AID. Yet a small American company with a low-cost innovative product that spent thousands of its own Dollars to attend the fair at the invitation of the U. S. Government now is unable to sell its product because an import permit and a small amount of AID funds (roughly $30,000) are denied. This unfortunately is also the experience of some other American companies that participated in the fair.

It is difficult to imagine the German Government, or the French or Japanese Governments, encouraging their firms to participate in a trade fair, the later results of which are inability of the firms to be paid for their products even though the products are needed and wanted.

Even if existing AID funds loaned or granted to Zimbabwe are "exhausted" in the sense that they are all allocated, we are well aware that large, new AID commitments will be made to that country very soon. What we would like therefore, is either an allocation to our distributor from existing funds, or assurance to our distributor that he will shortly get an allocation from new funds to be committed to Zimbabwe by AID. The very competent personnal at the AID Mission in Zimbabwe should be able to accomplish this with the local Government very easily once they are fully apprised of the situation and the desires of Washington. If it cannot be accomplished, the net result of our attending the fair has been to waste company money and resources.

Needless to say, the sooner this problem is solved the better -- by not being able to ship our machine this month, we and our distributor already have missed one of the best sales times for agricultural equipment in Zimbabwe.

What Silopress needs now is help from the U. S. Government. Anything you are able to do on this matter will be much appreciated by myself and my associates.

Sincerely yours,

Raymond C. Malley
Vice President
International

AGENCY FOR INTERNATIONAL DEVELOPMENT
[illegible]

February 22, 1983

THE ADMINISTRATOR

Dear Mr. Chairman:

Thank you for your letter of January 3, regarding U.S. business participation in Rural Development Technology Exhibition in Zimbabwe. We share your interest in promoting opportunities for U.S. small businesses overseas, especially in the transfer of commercial technology to LDCs. For this reason we participated in the technology exhibition in Zimbabwe. However, there seems to be some misunderstanding of our role in that exhibition.

Our primary intention was to introduce U.S. small manufacturers and their technology to commercial firms in the LDCs. We were not there to promote U.S. commodity exports although we recognized a potential for this type of commercial transaction. Rather we hoped that U.S. firms would agree to license or otherwise transfer their technology to LDC commercial firms for manufacturing purposes in the LDCs. I believe we made it clear to all participants that we were not in a position to provide financing either in the form of commodity credits or venture capital for any commercial relationships between U.S firms and LDC firms.

The lack of hard currency for financing imports, joint ventures, and licensing arrangements is a major problem in almost every country with which AID deals. In a few selected countries, AID has established a commodity import program to assist those countries in obtaining vitally needed imports, i.e., those that are necessary to sustain the economy and to meet priority development needs. However, in most AID-assisted countries, we rely exclusively on project financing and do not have commodity assistance programs. Where we do have commodity assistance programs, small firms are, of course, welcome to participate in the competitive procurement process when they can supply the key commodities as selected by AID and host governments.

The Honorable Berkley Bedell
Chairman
Subcommittee on Energy, Environment
  and Safety Issues Affecting Small Business
House of Representatives
Washington, DC 20515

I hope to advise you shortly as to our decision on participating in the Manila Trade Fair. We are most interested in this project, I assure you and will probably proceed. It is our intention to continue with at least three more properly planned such exhibitions in order to provide an adequate base of experience upon which to judge their effectiveness.

Sincerely,

M. Peter McPherson

BERKLEY BEDELL, IOWA
CHAIRMAN

NORMAN SISISKY, VA.
JIM COOPER, TENN.
JAMES R. "JIM" OLIN, VA.
RICHARD RAY, GA.
JOSEPH P. ADDABBO, N.Y.
HENRY B. GONZALEZ, TEX.
C. ROBIN BRITT, N.C.

United States House of Representatives
Committee on Small Business
Subcommittee on General Oversight and the Economy
B-363 Rayburn House Office Building
Washington, D.C. 20515

SILVIO O. CONTE, MASS.
DAVID DREIER, CALIF.
SHERWOOD L. BOEHLERT, N.Y.
MICHAEL BILIRAKIS, FLA.

MARK L. LEVINE
SUBCOMMITTEE STAFF DIRECTOR
202-225-8944

DONALD C. BERNO
SUBCOMMITTEE MINORITY COUNSEL
202-226-3420

March 8, 1983

Hon. M. Peter McPherson
Administrator
Agency for International Development
21st St. and Virginia Ave.
Washington, D.C. 20523

Dear Mr. McPherson:

Thank you for your letter of February 22, which was in response to my letter of January 3. I wish to remind you that a letter I sent to your office on December 22, 1982 is yet unanswered.

In your letter you state that although A.I.D. recognized potential commercial transactions from the participation by U.S. small businesses in the technology trade fair in Zimbabwe, A.I.D. was "not in a position to provide financing either in the form of commodity credits or venture capital for any relationships between U.S. firms and LDC firms."

Mr. McPherson, I do not believe that I have asked A.I.D. to provide venture capital to anyone. Instead, I was writing on behalf of a business from my district that attended the Zimbabwe fair who raised a very valid and important concern. My constituent feels that his company's inability to receive a small share of the commodity import credits that the U.S. gives annually to Zimbabwe could prevent him from closing a joint venture to transfer his technology to a Zimbabwean small business. It is exactly this type of joint venture and transfer of technology that your letter says A.I.D. hoped would occur. A copy of my constituent's letter is again attached for your reference. I welcome your comments.

Along these same lines, a witness at the December 9 hearing that I chaired, testified that because of soft currencies in developing countries, the Commodity Import Program administered by A.I.D. is important to the success of new commercial ventures in those nations. It appears that the lack of these credits threatens to delay or even prevent the closing of several deals arranged by U.S. small businesses at the trade fair in Zimbabwe.

From what I can interpret from your letter, A.I.D. currently plans to do nothing to help the U.S. small businesses who need access to these credits stemming from their participation at the Zimbabwe fair. This is most unfortunate. As my constituent says in his letter, it is difficult to imagine that the German, French or Japanese governments would take the same attitude. It certainly seems to me, that

(more)

because A.I.D. already manages our government's program to assist businesses with soft currency problems in selected developing countries, that the Agency would investigate ways to make some small share of the assistance available to small businesses who attend technology trade fairs that it participates in.

Mr. McPherson, at my subcommittee's December 9 hearing, the A.I.D. witness, Ms. Barbara Otis, told the subcommittee that the Agency would study the lessons learned from the Zimbabwe fair. While I applaud your efforts to continue A.I.D.'s participation in these technology trade fairs, I would be disappointed if the Agency did not apply the lessons learned in Zimbabwe in order to enhance those future fairs.

In this regard, my original questions remain unanswered. Has A.I.D. looked into what other governments do to resolve currency problems that otherwise would affect their domestic firms' ability to follow up on commercial leads stemming from these fairs? And what proposals is A.I.D. considering to make commodity credits more readily available for the purchase of products displayed by U.S. small businesses at future technology trade fairs sponsored in part by the Agency?

I look forward to your reply.

Sincerely,

Berkley Bedell

BB/mjl

UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

April 25, 1983

THE ADMINISTRATOR

Dear Mr. Chairman:

Thank you for your letter of March 8.

Under present arrangements with the Government of Zimbabwe all allocations of foreign exchange under the Zimbabwe Commodity Import Program (CIP) are the responsibility of the Government of Zimbabwe. The rejection of the request of Silopress' local representative, Zimbabwe Farm Equipment, for a foreign exchange allocation is not unusual. Many firms receive several rejections, as the list of applications is long and many importers have been waiting for years to import U.S. equipment, spare parts and other urgently needed capital goods. In the course of our negotiations on the CIP, it was agreed that in exchange for Zimbabwe's commitment that 80 percent of the foreign exchange provided under the CIP would go to the private sector, A.I.D. would accept the existing foreign exchange allocation system.

A.I.D. has subsequently discussed with the Government of Zimbabwe the technology represented by Silopress and has suggested that it might be worthwhile to consider some trial use of the technology. We have scrupulously neither promoted nor advocated any particular equipment or brand name in the allocation of the CIP program. This would be, in our view, a conflict of interests since there are many U.S. companies with local representatives who are vying for foreign exchange under the A.I.D. program. The demand far outstrips availability and the Government of Zimbabwe has given, and will continue to give, priority to much needed replacement equipment and raw materials for firms involved in manufacturing products for import substitution as well as export. However, we will query our Mission to see to what extent Silopress will be eligible for CIP funding and to what extent the Zimbabwean government considers Silopress a high priority for the allocation of the foreign exchange required.

As is customary, A.I.D. has provided Silopress' Zimbabwean representative, Zimbabwe Farm Equipment, details on the CIP program and how it operates. They should continue to pursue the allocation for the equipment that they wish to import with the Ministry of Trade and Commerce.

The Honorable Berkley Bedell
Chairman
Subcommittee on General Oversight
  and the Economy
Committee on Small Business
House of Representatives
Washington, D.C. 20515

The Ministry of Trade and Commerce now considers the 1982 Commodity Import Program fully committed. A.I.D., however, is planning a similar program for 1983, which should be operational by late May. In addition, there is an Agriculture Sector Assistance Program which has a commodity import element, under which agricultural equipment is to be financed. As with the Commodity Import Program, these funds will be allocated according to Government of Zimbabwe priorities.

A.I.D.'s intention is to assist small businesses as much as possible in these matters. It was for that purpose that A.I.D. sponsored the U.S. participation in the Bulawayo Rural Technology Exhibition through small technology firms which would be interested in joint ventures or licensing arrangements for local manufacturers. To date ten such arrangements have been concluded as a result of the Exhibition.

Other exporting countries face the same marketing problems that the U.S. faces in Zimbabwe for introducing new kinds of equipment. Given the relatively small size of its economy, the Government of Zimbabwe is reluctant to allocate foreign exchange for different kinds of equipment having identical purposes. For example, the French have been unsuccessful in attempting to introduce a Renault farm tractor. The Government of Zimbabwe, satisfied with the American equipment and supporting dealerships, has refused to make foreign exchange available for importing Renault tractors and a complementary inventory of spare parts.

As we proceed with further A.I.D. involvement in rural technology exhibitions, we will do what we can to lay the groundwork for support of U.S. participants in their follow-up effort to market their products. However, there obviously will be constraints on what A.I.D. can do in this area. And, as noted in my letter of February 22, our basic interest is in assisting small U.S. firms to license or otherwise transfer their technology to LDC commercial firms for production of the commodities in the LDCs, which leads to employment and possible foreign exchange earnings, as well as assist the U.S. firm in its growth.

Sincerely,

M. Peter McPherson

APPENDIX E.—ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD BY DONALD V. EARNSHAW

EXHIBIT 1

INTERNATIONAL TRADE ADMINISTRATION,
Washington, D.C., December 18, 1982.

HON. BERKLEY BEDELL,
House of Representatives,
Washington, D.C.

DEAR MR. BEDELL: During the recent hearing before your committee an impression was created by some of the witnesses that the Department of Commerce export promotion activities primarily support big business. The facts are that just the opposite is the case and I want to present them to you for your information and for the record.

Approximately 86 percent of the clients that use our services are companies with less than 250 employees; 73 percent have fewer than 100 employees. In 1982, our trade specialists assisted over 1,000 small businesses with their first export sale. We aided more than 2,100 companies already exporting to expand in new overseas markets. The combined shipments of these companies totaled almost $200 million in new export sales and over $1.1 billion in new market sales.

We believe the developing countries offer significant export opportunities for United States small businesses. This year about 60 percent of our promotion resources will be concentrated in developing country markets. This compares to about 50 percent last year and about 40 percent the previous year.

We place the highest priority on assisting U.S. small- and medium-sized businesses. Our greatest challenge is to make these firms aware of the services that we offer. I would appreciate it if you and your colleagues would help us spread the word among your business constituents.

Thank you again for the opportunity to speak to your committee.

Sincerely,

DONALD V. EARNSHAW,
Deputy Assistant Secretary for Export Development.

EXHIBIT 2

Export Development Plan
for the
Renewable Energy Industries

United States Department of Commerce
International Trade Administration
Office of Capital Goods Industries

Executive Summary
Attachment I

Data Current as of:
October 1, 1981

I. Executive Summary

1 Definition of Industry Sector

The Renewable Energy Industries sector consists of three industry subsectors which are commercially viable and four industry subsectors in relatively early stages of research, development and demonstration. The titles of all seven subsectors and the major product categories of the commercially viable subsectors are listed below. (Please refer to Section II of this Export Development Plan for further information regarding product categories of those subsectors currently under research and development.)

A. Solar Thermal Energy

Major Product Categories

(1) Passive Systems

- (a) Prefabricated Components
- (b) Design/Contracting Services

(2) Active Systems

- (a) Collectors
  - i) Low Temperative (less than 43 C)
  - ii) Medium Temperature (43 - 82 C)
  - iii) High Temperature (greater than 82 C)
- (b) Heat Transfer Apparatus, Pumps and Fans
- (c) Storage, Controls and Regulators
- (d) Electric Power Generators and Receiving Stations
- (e) Other Components

(3) Services (including engineering, installation and consulting).

B. Photovoltaics

Major Product Categories

(1) Systems Components

- (a) Cells, Panels, and Arrays
- (b) Power Conditioning Devices (e.g., inverters, charge and discharge controllers, regulators, etc.)
- (c) Energy Storage Devices

(2) Panel Assemblies (DC power only)

(3) Panels and Inverters (AC power)

(4) Panels and Motors (rotory power)

(5) Power Packs (AC/DC power)

(6) Home Building Electrical Power Systems

(7) Community or Industrial Power Systems

(8) Packaged Products (i.e., system may include such enduse equipment as pumps, fans, refrigeration equipment, microwave telemetry, sensing and recording devices, etc.)

(9) Services (engineering, installation and consulting)

C. Wind Energy

Major Product Categories

(1) System Components

- (a) Wind Turbines, Shafts, and Gearboxes
- (b) Towers
- (c) Generators (AC/DC)
- (d) Power Conditioning Devices (e.g., inverters, controllers, etc.)

- (e) Energy Storage and Control Devices
- (f) Measuring Instrumentation

(2) Mechanical Systems

- (a) Water Pumping Systems
- (b) Other Mechanical Applications

(3) Electrical Power Generation Systems

- (a) Small Scale (less than 10 kilowatts output)
- (b) Intermediate Scale (10-100 kilowatts output)
- (c) Large Scale (100 kilowatt - several megawatt output)

(4) Services (construction, engineering and consulting

D. Biomass Energy

E. Low-Head Hydroelectric Power

F. Ocean Energy

G. Geothermal Energy

2. Status of Working Relationship

FOR INTERNAL USE ONLY

3. Analysis

3.1. General Conclusions

An analysis of the Renewable Energy Industries sector confirms that, with exception of sales of woodburning stoves and gasohol, the four subsectors in relatively early stages of development had limited or negligible domestic and export sales in 1979 and 1980. Close analysis of the three commercially viable Renewable Energy Industries subsectors indicates that, although moderate to rapid growth in both domestic and export sales has occurred during the past several years, domestic growth has been aided by government policies and financial incentives or support, and export growth has been basically attributable to increased sales by large corporations with international sales and distribution networks.

The percentage of exporting firms within the combined three leading sector industries is greater than that estimated by the Department of Commerce for all U.S. industries. This suggests a shared assumption within the Solar Thermal Energy, Photovoltaics, and Wind Energy subsectors that expansion of their sales base through exporting can more rapidly achieve economies of scale, and thus reduce product costs and prices for both their domestic and export markets. This is an important consideration, given the currently lower prices for comparable renewable energy products set by their overseas competitors.

However, the analysis also uncovers sector-wide trends of high export sales concentrations and (with the exception of the photovoltaics industry) correspondingly low levels of export activity among the majority of commercially active renewable energy firms. This reflects the general composition of the combined three subsectors, i.e., predominantly small and medium-sized firms with limited resources concentrated mostly on local markets. Even in the relatively export-oriented photovoltaics industry, the more numerous smaller firms, accounting for the minority of total industry export sales, register a lower level of export activity than that of the few large companies active in the industry's export market.

Although U.S. manufacturers of renewable energy products and systems currently manintain a technological edge over those produced by foreign companies, a number of factors neutralize this competitive advantage and hamper increased export sales by U.S. firms. These barriers to increased exporting are:

(1) the lack of familiarity and experience of small and medium-sized renewable energy firms with exporting methods and mechanisms;

(2) the insufficient availability of information regarding major and potential overseas markets, including country-specific economic, financial and market conditions, insolation, wind and water resources, renewable energy import and design policies or regulations, current/projected energy use and development, and potential joint venture partners;

(3) the lack of awareness of renewable energy technologies, products, and systems applications among potential exporting domestic end-user industries, foreign based end-user industries, U.S. government export development personnel, and foreign government officials;

(4) the lack of overseas marketing, distribution and "contacts" network in major market areas among the vast majority of renewable energy firms; and

(5) lower renewable energy product and system pricing by foreign competitors, resulting from higher U.S. shipping costs and foreign government financial support for both research and market development.

3.2 Overall Sector Export Performance

Eport sales by the Renewable Energy Industries sector increased by 57% from 1979 to 1980, reaching a level of $36.1 million. Broken down by subsector, Solar Thermal Energy accounted for 24% of total sector export sales, Photovoltaics accounted for 69%, and Wind Energy accounted for 3%. Supporting products and services from all subsectors account for the remaining 4% of export sales.

Export sales of renewable energy products, systems and related services are expected to continue to grow in 1981, but at a much slower rate than in 1980 (primarily as a result of recessionary conditions in Europe and the increased value of the dollar relative to other currencies).

Sector-wide export sales are heavily concentrated. Ten companies within the three commercially viable subsectors accounted for 70% of the value of total sector-wide export sales in 1979. The remaining 30% was distributed across 115 companies. Similarly, one fifth of the firms in the three leading renewable energy industries (solar heating and air conditioning active collector, photovoltaics and wind energy) accounted for approximately three fourths of their combined 1980 export sales by value.

Although the percentage of renewable energy firms within these three industries which entered the export market in 1980 (28%) is significantly higher than the average estimated by the U.S. Department of Commerce for all U.S. industry (10%), export sales by these firms represented only 14% of the value of their total (domestic and international) sales in that year.

3.3 Solar Thermal Energy

The Solar Thermal Energy subsector consists of two separate industrial groups producing products or systems related in concept but differing in applications. The solar heating and air conditioning (SHAC) industries, comprised of 500-600 firms, along with an additional 7000 related service firms, constitute the largest of the two groups. This industry group is further divided into differing approaches towards solar applications (active vs. passive), several types of firms (systems design, manufacturing, marketing and service), and various end products (components, such as collectors, controls, etc., or total systems). Although a number of large companies operate within the SHAC industries, the majority of firms are small businesses operating on a local or regional basis with high labor content and low capital equipment/upfront financing.

The second industry group, collectively known as Solar Thermal Electric, is comprised of approximately 70 firms active primarily in research and development, and only secondarily in commercialization of energy systems for electricity generation and industrial heat process applications.

Total (domestic and international sales) of low-temperative collectors produced by the active SHAC industries reached $150 million in 1980, representing a 23% increase over 1979 sales. The annual rate of growth for these collectors during the period 1976 through 1980 averaged more than 40%. By comparison, sales of Solar Thermal Electric medium and high temperative collectors were very modest, reaching only a level of $20 million for trough concentrator collectors in 1980.

Export sales of all solar thermal energy products and systems in 1980 totaled $8.5 million, representing on increase of 37% over 1979 exports. Broken down by industrial group, SHAC export sales in 1980 of $7.4 million marked on increase of 45% over 1979 levels, while Solar Thermal Electric exports in 1980 remained unchanged from the level of $1.1 million recorded in 1979.

Export activities of passive SHAC equipment and products remained negligible in 1980. Sales of collectors and collector systems accounted for approximately two-thirds of all active SHAC products exported in 1980. The remaining one third was comprised of balance of system components, such as controls, storage tanks and pumps.

The most active export markets for SHAC collector firms were Europe and Asia, which together accounted for 69% of their export sales. Australia/New Zealand, Canada, and the developing countries in Latin America, Africa and the Middle East accounted for the remaining 31%.

Export sales were highly concentrated among those active SHAC collector firms operating in the export market. Eleven of these firms, each with annual export sales greater than $1 million, accounted for 77% of total 1980 collector exports. The remaining 23% was distributed among fifty additional firms. An estimated range of between 76% to 83% of all active SHAC collector firms did not record any exports in 1980.

Significantly, the level of exporting activity was very low among even those firms which did record export sales in 1980 , with exports representing only 6% of the value of total sales of the leading eleven firms and only 1% of the value of total sales of the remaining 50 firms.

3.4 Photovoltaics

Although smaller in size and value of total sales than solar thermal energy, the photovoltaics (PV) industry is the largest exporting segment within the Renewable Energy Industries sector.

In addition to servicing the market for various outer space applications (including satelite communications) for which it was developed, the photovoltaics industry is pursuing markets for the use of cells, modules and systems in remote communications, cathodic protection, navigational aids, water pumping for irrigation , and various applications requiring small and moderate amounts of reliable power in remote areas.

The photovoltaics industry consists of approximately twenty companies producing cells, modules and systems, and between forty to fifty companies engaged in research, development and demonstration of PV products. Companies involved in these activities range from small, specialized firms to large corporations, and include subsidiaries or divisions of six major oil companies.

In addition to differentiation based on type of activity, the industry is grouped by type of end product. While some firms produce only the photovoltaic cells and modules, other firms (known as Original Equipment Manufacturers or OEM's) just produce integrated systems for one or several applications, and still other firms produce an array of cells, modules and systems. An unusual aspect of this grouping is that OEM firms act as a direct market and an indirect marketing agent for producers of cells and modules.

Total (domestic and international) sales of PV cells, modules and systems (excluding space applications) reached a level of approximately $49 million in 1980, representing an increase of almost 69% over 1979 sales. This increase follows a trend recently established for photovoltaics of an annual sales growth rate of between 50%-70%.

Export sales of PV cells, modules and systems increased to opproximately $25 million in 1980, representing a growth rate of 79% from the level of sales in 1979. Exports in 1980 assumed for the first time the dominant role in industry sales, constituting 51% of the value of total (domestic and international) sales.

PV firms producing cells, modules and/or systems accounted for 92% of total exports. The remaining 8% was attributed to sales of integrated systems by OEM firms. Cells and modules became the major PV products exported, with their portion of export sales growing from 45% in 1979 to 51% in 1980. (Conversely, sales of systems dropped to 49% of total industry exports in 1980.) This shift in type of end product exported was most pronounced among those small firms with limited export sales. Cells and modules accounted for 70% of the value of export sales recorded by these firms in 1980, up from 52% of sales recorded in 1979. This indicates an increasing industry trend of supplying cells and modules on a world-wide basis to systems integrators, rather than producing and marketing the higher valued integrated systems themselves.

Similar to other renewable energy industries, exporting activity by the photovoltaics industry is heavily concentrated. Export sales by the industry's three largest firms accounted for 76% of total 1980 exports. Eight other PV firms accounted for 17%, while OEM systems integrators accounted for the remaining 8%.

Europe was the primary market for photovoltaic products in 1980, accounting for over one half of the industry export sales. Other major markets included Asia and the developing countries in Latin America, Africa and the Middle East.

3.5 Wind Energy

Despite the modest level of its current commecial activities, the Wind Energy subsector is projected to have considerable near-term growth potential.

Wind energy systems applications fall into two basic categories: 1) those using energy for mechanical functions, and 2) those using output for electricity generation. The immediate near-term potential for wind energy systems is in irrigation and other agricultural processes, cottage and other small-scale production, and small-scale non-grid electricity generation.

Out of approximately 50 companies which are direct producers of wind energy machines or systems, 4 firms manufacture mechanical systems, while 45 firms produce electrical systems (differing in scale of output capacity). The majority of electrical wind energy producers manufacture small-scale systems. Although most of the companies involved in wind energy are small, highly specialized firms, a number of large aerospace companies have become involved in the research, development and production of small, intermediate and large-scale electrical wind energy systems.

Total (domestic and international) sales of wind energy machines and related products or systems reached $19 million in 1980, representing an increase of almost 27% from 1979 sales levels. Electrical wind system accounted for 89% of 1980 sales, with mechanical systems accounting for the remaining 11% of sales.

With only $1 million in export sales, wind energy systems accounted for the smallest share of renewable energy exports in 1980. This represents a 9% decrease from wind energy export sales recorded in 1979. This sales decline reflects both the nature of wind energy industry exporting (i.e., limited to responding to inquiries generated through directory marketing lists or export agents), and the wider acceptance and greater attraction of other renewable energy products utilized in electric power generation in remote areas.

Significantly, only 5% of the value of total 1980 sales was attributable to exports, indicating a very low level of industry exporting activity.

Export sales of wind energy systems and products in 1980 were highly concentrated. Eight firms accounted for approximately 60% of all wind energy systems and products exported in 1980, and for three quarters of all electrical wind energy systems exported in that same year.

The most active export market for wind energy systems is North America (i.e., Canada and Mexico), which accounted for 42% of 1980 export sales. Other active wind export markets are Europe (21% of 1980 export sales), Central and South America (19% of export sales) and Africa (9% of export sales). The general markets considered to have the greatest potential for wind energy export sales are the low and middle-income developing countries concentrating on agricultural and rural economic development.

4. Strategy

The strategy proposed by the Renewable Energy Industries sector for this comprehensive Export Development Plan is primarily designed to enable the sector to simultaneously increase its share of the overseas market while securing its domestic base. By attempting to counter those factors perceived by the industry to be barriers to its increased penetration of major and potential markets, the strategy recognizes the validity and importance of the major, recurring trends evident in the "Analysis" section of this report (and highlighted in the "Analysis---Conclusions" portion of this section).

The industry proposes that government financial and policy support be continued for the near and mid-term future. This support would include a continuation of federally-sponsored renewable energy research and development, tax incentives, and export promotion activities. The industry's strategy also calls for federal support of industry efforts to influence the adoption of international renewable energy product standards, which, in turn, would increase the opportunities for U.S. firms to penetrate world markets.
Other policy objectives emphasized by the industry's strategy include: 1) identifying those non-tariff barriers affecting the photovoltaics industry that are to be lowered as a result of the MTN Agreement of 1979; 2) support for the concept of export trading companies and for a general export awareness campaign involving the benefits of these companies (following passage by Congress of enabling legislation); 3) and endorsing attempts by multilateral development institutions and United Nations agencies to encourage the development of renewable energy resources in the poorer developing countries.

The industry, through its major trade association, proposes that the relationship it has developed over the past two years with the Commerce Department be formalized by the inclusion of renewable energy export promotion activities in the Department's export development programs, the establishment of an "umbrella" Export Council, composed of representatives from all of the renewable energy industries, -and the implementation of a comprehensive export development plan.

To counter the lack of awareness of renewable energy technologies and products, the industry recommends that: 1) a "primer" describing various commercially viable renewable energy technologies, products and systems be distributed in executive summary format to U.S. Foreign Commercial Service Officers overseas and Commerce Department local district office personnel; 2) a combined product catalogue/ industry profile be created and disseminated by local DOC district offices to major export oriented industry trade groups and by Foreign Commercial Service diplomatic posts to overseas trade associations, industry groups, leading businesses and government officials; 3) another edition of Commercial News USA exclusively devoted to renewable energy be published and distributed overseas.

To increase the number of renewable energy firms entering the export market, the industry suggests increasing the number and effectiveness of export awareness seminars, surveying its membership to determine the export capabilities of member firms, and targeting these firms for specialized business counseling by the Department of Commerce district Offices. To meet the serious problem of availability of technical and market information, the industry seeks Commerce Department assistance in the maintenance of and continued access to the data base of the Solar Energy Research Institute, as well as additional market research to be identified by the industry and obtained by the Department of Commerce.

Finally, the industry proposes to neutralize the price and marketing network competitive disadvantages, which hinder increased U.S. renewable energy exporting activities, by recommending the implementation of an export promotion campaign which would reduce the costs associated with marketing and facilitate the matching of U.S. firms with joint venture partners (who can provide needed financial and marketing expertise in developing countries). The key elements of this export promotion campaign are:

a) encouraging and facilitating greater industry participation in major Department of Commerce-sponsored and other overseas and domestic trade events (exhibits, shows, fairs and missions);

b) recommending for Commerce Department sponsorship and sponsoring its own Industry Organized Government Assisted trade missions to major and potential market areas (Europe, the Far East, North Africa and the Middle East, and Latin America;

c) creation of both a video and a printed catalogue of U.S. renewable energy products and systems applications for exhibiting and/or distribution overseas; and

d) the creation of a sector-wide industry newsletter to disseminate commercial leads, joint venture opportunities and other information important to the various exporting renewable energy industries.

EXHIBIT 3

A Representative Sample of ITA's Export Programs and Services

I. Trade Events

- A. Exhibition Shows and Fairs

    (1) Solo Fairs (staging an exhibition where no suitable trade fairs exists)

    (2) Trade Shows (holding an exhibition in one of the U.S. Government's permanent facilities)

- B. Missions

    (1) Specialized Trade Missions (organizing business meetings for 6 to 12 U.S. firms in 2 to 3 countries)

    (2) Seminar Missions (presenting "generic" discussions by 5 to 10 U.S. firms on U.S. technology in 2 to 3 countries)

    (3) Industry-Organized, Government-Approved (IOGA) Trade Missions (supporting trade missions organized by U.S. trade associations, chamber of commerce, and state development agencies)

- C. Special Exhibitions

    (1) Catalog Exhibitions (displaying of the product catalogs, sales brochures, and other U.S. company graphic sales aids)

    (2) Video/Catalog Exhibitions (showing video tapes of live product demonstrations along with product catalogs).

II. Export Awareness Activities

- A. "How-to-Export" Seminars

- B. Specialized Business Counseling by local U.S. Commercial Service District Offices

III. Market Research

- A. Department of Commerce-contracted research on specific major markets
- B. Information from Foreign Commercial Service Officers assigned to U.S. diplomatic posts overseas.

IV. Export Services

- A. Trade Opportunities Program
- B. Automated Information and Trade System (AITS) (computerized data bank)
- C. World Trader Data Reports (WTDR)
- D. Agent Distributor Service
- E. Commodity Trade Lists
- F. Commerical News USA publication
- G. New Product Information Service

APPENDIX F.—AID MEMO, SEPTEMBER 21, 1982

UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON D C [illegible]

September 21, 1982

MEMORANDUM

TO : ASIA/TD, Gerrit Argento

FROM : PRE/PI, Stanley B. Scheinman

SUBJECT: Manila Trade Fair

I want to make sure that you are aware that PRE-P/I does not believe that support of such an activity represents the kind of priority which would justify use of its limited resources. The Zimbabwe expenditure was justified only because of perceived prior commitments.

Appendix G.—Memo From Energy Alternatives International, Inc., December 7, 1982

ENERGY ALTERNATIVES INTERNATIONAL, INC.
10200 W. FORTY-FOURTH AVENUE
WHEAT RIDGE, CO 80033 U.S.A.

Memorandum To: Distribution

From: Thomas G. West Thomas G. West

Date: December 7, 1982

Subject: Summary Report, U.S. Solar and Alternate Energy Trade Seminar Mission to South East Asia, November 4-17, 1982

Results

The 14-day mission has apparently proven to be a substantial success, based on my conversations with mission members during the last few days. The six participating companies have estimated that business of up to $23 million may have resulted directly from the three-country mission. More specifically, participating companies project 12-month business of between $15 million and $23 million in equipment sales, professional services, manufacturing licenses and joint venture arrangements. These projections are especially impressive at a time of world-wide recession and a historically strong dollar.

One company representative indicated that they were "overwhelmed" by the response they received. Another company indicated that the interest shown in the mission was "above" their "expectations," while a third company said they felt as if they were being pursued by "several suitors." One company spokesman, who has had substantial overseas marketing experience, was especially impressed with the effectiveness of the seminar mission format and local embassy support, observing that there is "no better way to go into a country."

The apparent high level of success of the mission may be attributed to four factors: (1) Selection of the most appropriate countries for this kind of mission; (2) selection of the proper companies and technologies to address needs and market potential in these countries (an important additional consideration is that most of the companies which participated are small, flexible, and open to technology licensing arrangements as well as product sales); (3) capable and conscientious organization of the mission by ITA staff in Washington, D.C.; and (4) outstanding preparation and support by Commercial Section staff in Manila, Bangkok and Jakarta.

The 12-month business projections for this mission compare highly favorably with the solar and renewable energy trade shows and seminar missions conducted during 1981, especially with reference to the small number of companies involved in the recent mission. The 1981 series of trade shows and seminars consisted of four major events in ten countries, involving 8 to 24 U.S. companies. Projected 12-month sales for the four events totalled over $60 million. The largest single event, shows and seminars in four European countries, resulted in projected sales of $42.9 million, involving 23 U.S. companies and over 3000 European attendees. Consequently, the 1981 European event resulted in average projected sales of $1.86 million per company, whereas the 1982 Far East seminars resulted in a high of $3.8 million per company or a low of $2.5 million per company in projected business, on average.

The return on investment for this seminar mission is potentially quite high. It is estimated that the private and government costs of the mission total approximately $45,000 (not including participant salaries). If projected sales of $23 million were to be realized, the mission would represent a return of 511 times the investment. If the lessor figure of $15 million were to be realized, the multiple would be 333 times the investment. Clearly, the mission should be considered a substantial success even if only a small fraction of projected business is ultimately realized.

Participants

Trade mission participants included: Herbert Mulqueen and Matthew Mendis, consultant, representing CHH Technology, Warsaw, Virginia, a manufacturer of industrial and commercial biogasification burners designed to be easily retrofitted to existing boilers; Dr. George Self of Chronar Corporation, Princeton, New Jersey, a manufacturer of thin film amorphous silicon photovoltaic modules and arrays; Norman Lutkefedder, consultant to Intersol Power Corporation, of Denver, Colorado, and Washington, D.C., a manufacturer of photovoltaic concentrating arrays and mobile power systems; Todd Williams of Pacific Analysis Corporation, Honolulu, Hawaii, a systems engineering and energy management firm specializing in geothermal, hydroelectric, photovoltaic, solar heating, biomass, and wind systems as well as other non-solar technology areas; Dr. Donald Anderson of Suntec Systems, Inc., St. Paul, Minnesota, a manufacturer of line focus solar thermal concentrator collectors for medium temperature applications; local representatives of the 3M Company, St. Paul, Minnesota, a manufacturer of solar energy collector and control films (in Bangkok only, the 3M presentation was given by Myles McNiff of company headquarters); and, of course, myself as mission director.

A manufacturer of small hydroelectric equipment (William Delp, Independent Power Developers, Inc., Sandpoint, Idaho) was also scheduled to participate in the mission, but cancelled at the last minute because of pressing company obligations. This was an especially unfortunate situation because small hydro resoures are prevalent in the region, interest is high, and a number of projects are being developed (with ADB, USAID and other funding sources), some of which are currently in the procurement stage. If a small hydroelectric manufacturer had participated in the mission, it is highly probable that significant additional business could have been reported. Specific inquiries received on the mission have been forwarded to Independent Power Developers.

Observations

- The mission saw evidence of continued aggressive marketing efforts in the region by European and Japanese solar companies with the direct support of their governments. For example, a story on a major photovoltaic project, largely supported by the German government, appeared in the Manila "Business Times" on the very day the mission arrived in the Philippines. The village power project, reported to be one of the world's largest solar plants," is to have an output of 10 kilowatts and is to cost 22.3 million Philippine Pesos"(US$ 2.55 million). The "German agency for technical cooperation" is to contribute 92 percent of the cost, while the Philippine Bureau of Energy and the Philippine National Oil Corporation are to provide the balance of the cost. The project "would eventually install a solar-powered communal television set, a refrigerator for the village's medical supply, a deep-well pump for drinking water, an irrigation pump, and a solar powered communication link up with (nearby) municipalities." The project is located in Doña Remedios Trinidad, an agricultural village of 2000 in Bulacan Province, Luzon, and is to be completed in January 1983. Similar projects, supported by the German government, have been in operation in Indonesia for more than a year.

- It is also evident that the American presence in the region is generally much less well established than that of European and Japanese companies. One area businessman indicated that he "would like to do more business with American companies, but when I need something, it is always a Japanese company representative who is at my office door." Perhaps the new U.S. Export Trading Companies could help to correct this situation (as well as the establishment of U.S. export incentives comparable to those of our competitors).

- Serious local interest in renewable energy technologies is indicated not only by full attendence and business projections, but also by the support given the mission by senior government officials in each country. Keynote speakers at the seminars included the Minister of Sciences, Energy and Technology in Bangkok, the Deputy Chairman of the Ministry of Research and Technology (BPPT) in Jakarta, and the Manager of the Energy Research and Development Center in Manila. Local U.S. Commercial Section staff should be commended for arranging this support. The presentation of USDOC bronze medals to these speakers proved to be an especially well received gesture of the mission's appreciation of this support.

Administrative & Logistical

- Mission Schedule: While each stop was increased to three days from the two originally scheduled, there is some concern that the time allowed was still insufficient to obtain definite initial results (to schedule first or second meetings with the most senior company or government officials, for example). One mission participant found it necessary to revisit two countries, while still in the region, to secure firm letters of intent. Serious consideration may be given to scheduling future missions for two countries only, one full week each. This would also allow time for more thorough initial briefings and introductory meetings which may be required as competition mounts in these technology areas.

- Presentation Schedule: Local conditions required split seminar sessions on the mornings of the first two days in one city. As was feared, attendance did fall off in the second day, a situation which was upsetting to the companies scheduled to speak the second day (time slots had been rotated throughout the mission). No clear solution to this problem is apparent, but it needs to be dealt with since it may be a major factor in a given company's mission results. Also, it was suggested that certain presentations would lend themselves to some fixed order of delivery (say, from more general to more specific papers). This may be appropriate for some missions, but would require cooperation and consent of all companies well in advance. Otherwise, each presentation should be considered to stand on its own.

- With regard to companies dropping out of the mission, it might be prudent to have each prospective participant identify a specific alternate speaker upon registration. Companies unable to specify an alternate speaker might be barred from participation.

- Airline Schedules and Tickets: Future mission participants should travel together, at least for flights between mission stops, to avoid unnecessary logistical problems for local Commercial Section staff. Also, it was discovered that substantial savings in airfare could be realized if the first mission stop had been Jakarta, rather than Manila. Although this is but one factor in mission scheduling, it should be considered in the future.

- Briefings: While valuable briefings were provided prior to the seminars in each city, it is expected that more time and more extensive information will be required in the future, especially as the market becomes increasingly competitive. In addition to general economic and political trends, information might be provided on recent project experience (government and private), specific fuel and electricity rates, principal competitors already active in the area, details on major procurements in progress or expected, profiles of major companies likely to be encountered, etc. Some participating companies considered that local USAID staff would be well placed to provide this information (as well as others); but in at least one city, this information was not available until the mission was nearly complete. AID staff should be encouraged to become more actively involved in future missions.

- During the mission it was realized that the mission title "Solar and Alternate Energy" was confusing to potential attendees, who are more accustomed to a more restrictive use of the term. It is suggested that future missions be more specific, even if a more cumbersome title is required: "Renewable Energy: Solar, Photovoltaics, Biomass, Wind, Small Hydroelectric, Geothermal, etc.," as appropriate.

- A significant part of one company's anticipated business may be in areas unrelated to renewable energy. This underlines the value of such missions for companies which provide products or services in several related or unrelated areas. Such companies should be encouraged to participate in future missions and should be encouraged to at least briefly describe the full range of company capabilities, whether or not they are related to the main focus of the seminars. Seminar attendees often have varied areas of interest. That marketing one product may often lead to the sale of an unrelated product is a tendency which should contribute to the success of the new U.S. Export Trading Companies, as well.

- Although a few hours had been allocated for a dry run of seminar presentations, it is recommended that sufficient time be provided for a full scale dry run in the future. Also, some participants observed that a better balance should be struck between technical content and more simple and direct presentations designed for a non-technical, commercial audience. Some companies suggested that it would be helpful if video equipment were made available during future missions.

- There should be provision for adequate followup of mission results at, say, 12 and 24 month intervals to establish a basis for realistic expectations of mission performance. Although it is likely that some current expectations may not materialize, other substantial business leads may result from the mission which were not apparent initially. In many cases, substantially greater business should be expected in the second year than the first. Questionnaires completed during the mission cannot reflect some important business possibilities which often will not be evident until one or two weeks after the completion of the mission.

Distribution

L. Garden, ITA, USDOC
W. Walmsley, ITA, USDOC
H. Mulqueen & M. Mendis, CHH Technology
G. Self, Chronar Corp.
C. Sills & N. Lutkefedder, Intersol Power Corp.
T. Williams, Pacific Analysis Corp.
D. Anderson, Suntec Systems
G. Armstrong, 3M Company
T. Moore, Com. Section, Manila
B. Ryno, Com. Section, Bangkok
F. Kline, Com. Section, Jakarta

APPENDIX H.—ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

SOLENERGY CORPORATION
171 MERRIMAC STREET · WOBURN, MASSACHUSETTS 01801
TELEPHONE (617) 938-0563 • TELEX 95-1677

December 2, 1982

Mr. Mark Levine
United States House of Representatives
Committee on Small Business
Subcommittee on Energy, Environment and
Safety Issues Affecting Small Business
B-363 Rayburn House Office Building
Washington, D. C. 20515

Dear Mr. Levine:

Attached is testimony which we would have given during the hearings next week. As you can see, it is designed to fit into your time allotment.

We have asked SEIA to bring up some of these points also.

I am enclosing some additional information which you can use at your discretion.

Very truly yours,

Robert W. Willis
President

RWW:che
Encs:

TESTIMONY TO THE HOUSE OF REPRESENTATIVES
COMMITTEE ON SMALL BUSINESS
SUBCOMMITTEE ON ENERGY, ENVIRONMENT AND SAFETY ISSUES AFFECTING SMALL BUSINESS

DECEMBER 9, 1982

Solenergy Corporation welcomes the opportunity to testify on Marketing Opportunities in the Photovoltaic Industry. Solenergy finds itself in a unique situation; it is the only small business manufacturing solar cells and modules for terrestrial photovoltaics. It is also a fact we have received little government support for R & D or demonstrations over the four years we have been in business. Albeit a chosen one, we must compete with large company subsidiaries with virtual unlimited resources such as Arco Solar, Exxon, Standard Oil of Indiana, CGE France and the like.

The problems of cash flow, funding internal research and development and limited capital resources including venture capital, are evident with all small business, especially in the present economic and energy climate. This, coupled with the necessity of doing business overseas, presents unique problems to the small photovoltaic manufacturer.

The photovoltaic market, as visioned by a United States manufacturer, conventionally breaks down into four segments: (one), the United States Government demonstration program; (two), the specialty and remote commercial market in the United States; (three), the research and development phase of the Government program and (four), the overseas market.

The U.S. Government demonstration program buys on price in order to show decline in cost with volume purchases. This is a straightforward volume/price relationship demonstration and depends on large raw material silicon purchases to decrease raw material prices, improved manufacturing techniques and obviously some good guesswork as to learning curves showing what clever technologists might accomplish. Large companies can support such investment risks while smaller ones cannot.

Large demonstrations do not offer any hope to small business. They cannot compete on price nor with the engineering requirements. Such large demonstrations are only useful to large businesses to reduce inventory and maintain production and in our opinion, of limited use in promoting a successful industry. We as a small business would rather see a multiplicity of smaller demonstrations where we can participate. This, however, may be a non-problem in the future since federal funding for demonstrations has virtually disappeared.

The specialty and remote commercial market in the United States is one that supports the photovoltaic industry. We believe this market segment is growing and will be an important factor in the future and with specialty products that perhaps offer a competitive edge to small business. The needs by federal agencies to fulfill tasks in remote areas is an important part of this market segment. Small business support on an active annual basis by DOD, FAA, BLM, Forest Service, Park Service and others help to maintain a base level of output while new development progresses.

The Research and Development phase of the Government's program has diminished with funding. As the 1982 funding will be a third the size as it was in 1980, Research and Development programs will suffer greatly, whether small or large business. Small business will suffer the greatest. Whether the Small Business R & D Act will help this situation remains to be seen.

Finally, participation in overseas markets is a must if a manufacturing facility is to grow. As mentioned earlier, it is unusual for a small manufacturer to jump into the international market before having solid ground at home. Solenergy feels that the Government can assist small business together with the rest of the industry especially in overseas markets which we feel is the argest growth opportunity, but technology promotion is required especially o lesser developed countries.

We have three specific suggestions:

1. The sponsoring of seminars such as was run by the U.S. Consul in Stuttgart last year. This brought together U.S. manufacturers with European users. The key in this seminar was its relatively low cost to the manufacturer while giving us the opportunity to talk and show products. The only costs that were involved were travel to Stuttgart and living expenses. The Consul did not charge for exhibition space.

2. As a corollary to this single meeting concept, we would recommend a trade mission partially government subsidized. Such a mission could include one representative from each manufacturer and a visit to several countries. A partial attempt using this approach was done in 1981 in three cities in Europe. As far as I know, it was successful but Solenergy did not participate due to costs.

3. In addition, it is important to recognize the United States Government domestic market for remote applications and the role for small business. There is no question that this can be promoted more effectively to government agencies through programs such as the old Federal Photovoltaic Utilization Program or through the new DOD Renewable Energy Utilization Act with small business set asides to allow the dual existence of independent companies with the companies subsidized by large multi-national owners. We feel assistance to small business is essential to maintain a balance between large and small businesses. The problem will be that if small business such as ourselves cannot maintain themselves, the photovoltaic industry will find itself more dominated by large industry to the exclusion of small manufacturers.

I would like to include in my testimony the results of a workshop held by the International Institute for Environment and Development. The summation indicates the problems associated with renewable energy in Developing Countries and offers some insights to the problems.

SOLAREX

December 1, 1982

Congressman Berkley Bedell
Committee on Small Business
U.S. House of Representatives
Washington, D.C. 20515

Dear Congressman Bedell:

I enjoyed our discussion on the Photovoltaic Industry during your visit to Solarex earlier this year, and I appreciate the opportunity to comment on your upcoming hearing on the PV Industry.

As you know, I fully support your activities to keep the U.S. Industry the world's technological leader in Photovoltaic Energy Systems. In this regard, I would suggest that funds be supplied to the Department of Commerce to sponsor a large number of U.S. Photovoltaic Energy Trade Fairs in Africa, Asia and the developing countries throughout the world. One of Solarex' biggest obstacles to overseas sales is the lack of awareness on the part of the users of the feasibility and viability of photovoltaic power for their energy needs.

Unfortunately, this has not always been helped by an Administration that has, by its recent solar budget reductions, sent signals to the world that solar energy is a "loser". An aggressive Department of Commerce support of photovoltaics through such Trade Fairs should help to overcome this negative impression.

Turning to another issue, Solarex' affiliate, Semix, Inc., has been working with DOE on a three-year Cooperative Agreement to do research and development on supplying the PV Industry with low-cost semicrystalline silicon wafers from which solar cells and panels are made. This agreement is one of only two in the DOE Photovoltaics Program that promises full pay-back of all Government funds upon its successful completion. However, the DOE has recently advised us of their intent not to continue the funding of this agreement, one year short of its completion, solely for lack of sufficient R&D funds.

Accordingly, I suggest that you ask the DOE representative at your December 9th hearing:

- Does he recommend the continuation of the DOE/Semix Cooperative Agreement just short of its successful completion and promise of full pay-back of all Government R&D funds?
- If not, why not?

I appreciate this opportunity to review my thoughts on the PV Industry, and I wish to again thank you for supporting this very exciting new energy source.

Sincerely,

Joseph Lindmayer

Joseph Lindmayer
President

JL/clc

cc: M. Levine
L. Magid

SOLENERGY CORPORATION
171 MERRIMAC STREET · WOBURN, MASSACHUSETTS 01801
TELEPHONE (617) 938-0563 • TELEX 95-1677

PHOTOVOLTAICS,
A SMALL BUSINESS OPPORTUNITY

Presented October 5, 1978 at the
Energy Industries Association Meeting
Boston, Massachusetts

R. W. Willis President Solenergy Corporation

Mobil, Exxon, Atlantic Richfield (ARCO), Hughes, SES (Shell), Motorola, Sharp, Philips-Endhoven, OCLI, Sensor Technology, McGraw Edison, Sollos, Solarex, Solar Systems, Solenergy, and Spire. The first few names are very familiar worldwide, but who are Sensor Technology, Solarex, Sollos, Solar Systems, Spire and Solenergy?

In fact, all of these names are a minority group who manufacture terrestrial solar cells. You may think I have omitted some names, but to the best of my knowledge I have not. No one else indicates serious involvement in the manufacture of cells for the terrestrial market.

Immediately, one comes to the conclusion that there are several very familiar and large names - Mobil, Exxon, ARCO, Hughes, Motorola, Sharp, Philips - but who could the others be? One might say, "Some insignificant businesses, compared to these names" - but, in fact, discover on careful investigation that they aren't insignificant at all. One is perhaps the major supplier of terrestrial photovoltaics; one, a recognized name in photo-diodes; another, an old timer; another, run by an ex-executive of one of the recognizable names; and another, an in-between (not big, not small) but with specific expertise and resources - all technical, all knowledgeable and all committed to terrestrial photovoltaics.

The next logical question which arises is how can these "little guys" compete with those "big guys"? I feel very strongly that they can.

The photovoltaic market conventionally breaks down into four segments: one, the U.S. Government demonstration program; two, the overseas market; three, the specialty and remote commercial market; and four, the research and development phase of the Government program. The U.S. Government demonstration program must buy on price in order to show decline in prices with volume purchases. This is a straight forward volume/price relationship demonstration and depends on large raw material silicon purchases to descrease raw material prices, improved manufacturing techniques and obviously, some good guesswork as to learning curves showing what clever technologists might accomplish.

I do point out that my personal opinions support the Department of Energy goals and I feel that they can obtain their targets. I have several reservations in approach, but basically I am a believer. The program is sound and feasible and I urge everyone to study it. My position is supported by my colleagues and it is attainable. The program has some deficiencies as all early programs have, since it is a big program; cost/quantity/quality sensitive and open to public and congressional scrutiny.

How can a small business participate in such a program which is analogous to the space program? It is my opinion that the small business should aim for the quality aspects of the program. Quality is most important in any Government program, even when cost is stressed. While large businesses concentrate on large volume/low cost, perhaps small businesses should look at quality, stressing new developments, innovative thinking and maximization of resources.

There are several concerns to the small businessman which must be addressed openly to both the Government and large competitors, and, most of all, to the raw material suppliers.

Silicon is the major raw material and it is generally purchased from the several major suppliers. It is essential that the Government assure small businesses that this major raw material be available to small photovoltaic manufacturers at competitive prices.

The purchase price/quantity relationship must consider the small manufacturers and small businesses must be offered the opportunity to compete against large purchasers. My concern especially applies to the Government program, and innovative thinking by the Government must insure small business participation and competitiveness especially in relation to raw materials.

I also feel there is a tendency to take the position that only large businesses can attain the goals of the Government program since the goals are too far reaching for any small business. This is a dangerous path, since significant contributions can thus be dismissed in an industry which has not yet learned to crawl, much less walk.

How can a small business participate in the overseas market? This is the most difficult market for a new small business with limited resources. I would suggest the small business concentrate on establishing one good relationship with a larger overseas company which wants to be involved in photovoltaics. There are several avenues for accomplishing this end such as using the Department of Commerce programs:

1. "TOPS" - The Trade Opportunities Program, which publishes a list of interested overseas correspondents in agencies, distributors, etc.

2. Commerce Business Daily - This indicates overseas market procurements (and domestic) and is a necessity for small businesses.

3. WTR - World Trader Report - This provides up-to-date evaluation of overseas correspondents.

Overseas product advertising in trade periodicals, business newspapers, participation in United States trade shows which draw foreign visitors, utilization of specialty export companies based domestically - all are methods of encouraging overseas business.

The general prognosis for small business overseas is difficult, costly and long term. Overseas businessmen tend to build up personal relationships over many years and thus the new photovoltaic supplier must rely on uniqueness of product and desireability of product line to obtain overseas representation. Even then, success is difficult since a small business cannot invest in the personal relationships to sustain overseas business, especially due to lack of funds to maintain expensive overseas trips.

Can the large companies give the small photovoltaic consumer the attention, quick samples and the personal contact that are necessary in such specialized marketing situations? The odds are that they will find this difficult. Thus, the small photovoltaic businessman can concentrate on specialty products: price/service relationships contrasted with price/volume relationships.

There will be many small specialty photovoltaic applications ranging from radio battery rechargers to environmental monitoring power devices; both Governmental and commercial sales. Service and marketing skills will be predominant with competitive price following.

Photovoltaic Research and Development programs are most difficult for the small business, unless they are already focused on specialty R & D. A new business has the difficulty of attempting to put the contract before the engineer, while the Government demands a show of capability and then will consider the merits of the proposal. I do not have a simple solution to this dilemma without complicated recruitment mechanisms and I am not sure how a new photovoltaic business obtains R & D contracts without the initial research investment. Development contracts may be easier as the small business has this capability, probably, in-house and available. It seems to me that this opportunity lies with existing small, capable research firms which already have specific expertise.

Let us now turn to some general small business considerations which should encourage involvement. The policy of the United States Government is to provide small business set-asides, a legal binding commitment on procurements whereby the Federal Government will reserve a certain amount of procurements for small businesses. At present, the Department of Energy uses "Small Business Participation", rather than set-asides. "Participation" has no legal binding whereas set-asides do. It is up to the small business to see that set-asides are mandated. We believe that DOE is receptive to having small businesses provide at least part of their photovoltaic needs provided they qualify and has, in the past, attempted to accomplish this end. It is particularly encouraging to see that the Senate version of the McCormick bill now has a 10% small business set-aside.

In a recent conversation, someone pointed out to me that over 80% of the DOE photovoltaics contracts went to large businesses. I was curious about this: the approximate percentages in 1977 were 62% to large businesses, 10% to Government laboratories, 13% to universities and 15% to small businesses. In each segment, except the Government laboratories, one-half or greater of the procurements were provided by four companies. As a small businessman, I believe that the small business share should be increased, but all segments should show more diversity.

The small business should develop or promote specific expertise. There are a multitude of excellent examples: one where the expertise of ion implantation was used; one where the company developed a new photovoltaic product capability; and another, capability in market studies. There must be specific areas since the competitive larger companies have broad capabilities in many areas. It is also suggested that a small business can team with other small or large businesses which have, jointly, specific talents.

What is necessary for a small business to become involved in the manufacture of photovoltaics? Although I encourage this participation, I do feel that one must be realistic and face the difficulties associated with starting a new business, especially against large competitors with virtually unlimited capital.

- Technology is a must, since photovoltaics is a high technology business.
- Experience and knowledge of the market, the people and the problems.
- Fortitude to overcome the depression associated with any new business start-up.
- Persistance to go forward with your plan.
- Money to support yourself while you are going through alternate fits of technology, experience, fortitude and persistence.

Money is needed for the growth and sustenance of the small business. Thus, it is necessary for the businessman to have some plan as to how to obtain the working capital necessary.

The Small Business Administration has a Solar Energy Loan Act signed by the President in July. This act permits the SBA to lend money to qualified alternative energy manufacturers, including photovoltaics manufacturers. The regulations have been published for comment and key words include: "recognizing that greater risks may be associated with loans made to business concerns in this field"; "it is the intent of Congress that the paperwork burden and regulatory impact.....shall be minimized".

I should point out that this law also includes words such as, "quality of product", "technical qualifications of the applicant", etc. Congress, through the SBA, has offered an opportunity for providing the funds for small businesses, with limitations. There is a discussion of this act tomorrow.

It is important that the SBA use caution in administering these funds so that qualified companies realize their benefit and the opportunists are excluded. The SEIA can play an important role in advising the SBA as to qualifications of recipients.

There are also other possibilities for the supply of capital: small business investment companies; state resources and private venture capital sources.

From experience, the road is difficult even with product expertise and suitable plans. I can assure you that there are many more days of disappointment and frustration than there are of hopeful beginnings, but persistence is the key, and with support of associates there certainly is an opportunity for the small manufacturer.

EXHIBIT 2

INTERNATIONAL TRADE COUNCIL
750 Thirteenth Street, S.E., Washington, D.C. 20003 U.S.A.
Telephone: (202) 547-1727

TO: United States House of Representatives
Committee on Small Business
Energy Subcommittee

RE: Hearing on the Photovoltaics Market
December 9, 1982

Mr. Chairman and Members of the Committee. I am Dr. Peter Nelsen, an economist and President of the International Trade Council (ITC), a trade association representing exporters throughout the United States. I am also Chairman of the International Development Institute (IDI), a non-profit research and educational foundation dedicated to education and applied research related to overseas development and the transfer of appropriate technology to improve the quality of life around the world.

It is indeed a privilege to have this opportunity to submit testimony for the record of this Committee on the subject of Photovoltaic exports, because the factors that limit our share of the world market in this category also apply in many other commodities where we are loosing markets to our overseas competitors by design or by benign neglect.

The United States needs a concise and consistent foreign trade policy which should have as its foundation the axiom that, whereas our right and ability to pursue "life, liberty and happiness" is a function of economic freedom - therefore, the government shall not interfere with a businesses' right to develop its export potential.

Except in the case of a clear and present danger to the security of the United States, the government must not impose embargoes or other restraints of trade on international commerce. Past incidents of embargoes and trade restrictions have discouraged U.S. producers from developing export markets for their products and it has labelled the U.S. as an unreliable trading partner by other countries.

A second axiom of our foreign trade policy should be to compel the cooperation and initiative of the federal agencies to cooperate in every way possible, consistent with the law, to provide information and to protect the rights and interests of the U.S. producers who are willing to risk their capital, time and other resources to serve the world market.

The exporter,or potential exporter, has experienced that it takes years of "net working" to establish contact with the appropriate government offices to obtain the up-to-date information needed by a producer to intelligently establish his company export policy as to which countries he can effectively do business with, vis-a-vis, regulations, trade barriers, foreign competition, etc.

Overseas, the U.S. Embassies and Consulates need to become more cooperative and accommodating to the needs of the U.S. businessman regardless of whether he represents a Fortune 500 company or a small business.

We know that "Freedom demands eternal vigilance" and the freedom to do business in the world market demands eternal vigilance against protectionism.

The dismal outcome at the GATT Conference last month, together with a steady stream of announcements of new protectionist measures and trade barriers, compels the United States to cease doing the same and adopting a positive, constructive free trade policy.

Negative measures hardly ever produce positive results. The way to reduce unemployment and stimulate the economy is to make it possible for the economy to meet the demand for products and services around the world.

The way for the Third World countries to earn the money to pay for our exports is by helping them develop their resources so that they can meet their local and regional demands and even export to the U.S. because a free world market benefits the U.S. consumers.

A 20-21% increase in U.S. exports would eliminate half of our foreign trade deficit; it would reduce our domestic unemployment from 9.5% to 5% and the economic multiplier effect of this increase of $25 billion in production to meet the export demand would stimulate the entire economy so that the increased taxes would reduce our budget deficit by 18-20%.

Since the GATT efforts at reducing trade barriers are not producing positive results, efforts should be made toward making bilateral trade agreements with any and all countries for reduction of tariffs on all commodities. An initial move to eliminating tariffs on all foodstuffs would be a great first step. It would induce other countries to follow in order to be competitive so that conceivably in five years' time, we could have a scattered common market reaching all over the world.

Secondly, elimination of sales' taxes on exports currently levied at various stages in the manufacturing sequence would result in an end product price competitive with European products on the world market.

The lack of appropriate export financing has been the major impediment to export competitiveness in many markets. Many commodities and products sold on the world market do not differ significantly from those originating in other countries, and in many cases the sale or loss of export contract lingers on the terms of payment rather than quality or the country of origin.

The Japanese government finances 35% of their exports, the French 30%, and the United States only 6%. These 6% are concentrated on a few of the agricultural commodities and on aircraft and a few other special groups by the EX-IM Bank. For most products and services, there are programs for financing on the books, but they are either not funded or not responsive to the real needs in the market place.

A responsive export financing program would permit small and medium size companies to enter the export arena on an even footing with the large companies who have established lines of credit and would allow all sizes of U.S. companies to compete with overseas producers of similar products.

The few write-offs that might occur would be covered many times over by reversing the lost production and lost tax revenue which now can only be estimated as a result of lost export sales.

We, therefore, urge passage of H.R. 3228 and S. 868 which would establish a special export financing fund.

Turning to the specific subject of this hearing, the Department of Commerce and A.I.D. both have the opportunity to significantly help expand the export of Photovoltaics as products and as part of turn-key projects.

A.I.D. obligated $782 million from 1978-1982 for energy projects in developing countries of which 68 projects for $127 million dealt with various forms of renewable energy, including photovoltaic cells.

According to a GAO report of June 1982, "A.I.D. is neither systematically or comprehensively identifying and recording lessons learned during the life of a project," and thus seems to contract for redundancy and replicates mistakes.

The International Development Institute (IDI) has designed a permanent year-round trade center known as TRADEXPO, a Research Center and an Educational Center which will help both exporters and overseas buyers overcome the information gap problem which exists.

The Data Base Information Center at the IDI Research Institute will record and disseminate experience learned from past and present projects as to the effectiveness, scope and limitations, both of on-going research projects and development projects so that A.I.D.'s funds can be spent more productively.

The Monthly Development Conferences beginning July 1983 that IDI has scheduled in cooperation with the University of Maryland will present the latest appropriate technology in each of the twelve basic human needs areas - to the government, academia and industry sectors - from the United States and to the 167 countries around the world.

The attendees will learn the latest technology, see it demonstrated in full scale production units and then be able to make their purchasing decisions for projects and services with the necessary, current information at hand.

According to an analysis that IDI did for the Senate Small Business Committee Survey on "Why Small Business is not going into Exporting," 87% of the reasons given by the respondents would be solved or eliminated if the companies participated in the TRADEXPO system.

A summary of the analysis is herewith attached, and we hope that the Committee will support the one-time-only start-up funding that we are requesting from the Commerce Department and support the request for cooperation between the various Executive Agencies that are involved with export, including the Commerce Department and A.I.D.

According to the Commerce Department's statistics, 80% of our exports are done by only 200-250 companies. The obvious remedy to the declining U.S. export share is to make it possible for the 250,000 companies that produce exportable products and services to enter the world market.

Development in the past has been the "trickle down system" of large projects - mostly government to government - then the "bottoms-up" theory of A.I.D. and Peace Corps teaching a LDC farmer how to be productive on one acre of land.

IDI presents the opportunity for thousands of small, medium and large companies to make contact with representatives from all 167 countries on a company to company basis in the private sector as President Reagan recommended (rather than company to government to government to company) to meet the need for thousands of small, medium and large scale projects, and for the buyers from those countries to come here to learn the latest technology, see it demonstrated and contract for their needs to be met.

EXHIBIT 3

SILOPRESS®

Silopress, Inc. USA
1915 Floyd Blvd.
P. O. Box 988
Sioux City, Iowa 51102
Telephone: 712/255-4569

December 3, 1982

Mr. Mark J. Levine
Small Business Committee
U.S. House of Representatives
Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Levine:

Attached is the statement that you suggested from Silopress pertaining to the forthcoming hearings of the Committee. Let me know if I can be of help in any other way, and I remain anxious to meet with Representative Berkeley Bedell at his convenience.

Sincerely yours,

R. C. Malley

Raymond C. Malley
Vice President
International

RCM/sre

Enclosure

STATEMENT TO THE SMALL BUSINESS COMMITTEE OF THE U.S. HOUSE OF REPRESENTATIVES BY SILOPRESS INTERNATIONAL LTD., SIOUX CITY, IOWA

Silopress International Ltd., a subsidiary of Silopress Inc., Sioux City, Iowa, understands that the Small Business Committee is now looking into the support given by various U.S. Government agencies to small companies that are exporting or attempting to export their products and services abroad. One of these agencies is the Agency for International Development (AID), which financed U.S. pavillion at the recent international trade fair held in Bulawayo, Zimbabwe.

In this context, Silopress is pleased to be provided with this opportunity to make a statement to the Committee.

We feel particularly well qualified to make a statement for two reasons - first, we participated in the Bulawayo fair; and second, a Vice President of our company, Raymond C. Malley, is a retired Senior Foreign Service Officer who actually set up and directed for three years AID's existing office dealing with the U.S. business community, including small companies in particular.

Silopress produces a rather unique product - a machine and system which compresses and stores large amounts of foodstuffs and silage in specially-made polyetheleyne bags for long periods of time. This system replaces the more traditional methods of storage, such as expensive silos and concrete or earth pits in the ground. The system is relatively inexpensive, easy to maintain, extremely versatile, and has unlimited capacity. It in reality represents a technological breakthrough in the field of food storage for both animal and human consumption.

Sales of the Silopress System have been going well in the United States despite the severe domestic agricultural recession. We are convinced that there is a substantial market for it in many parts of the world, and we have now launched a campaign to introduce the system and tap these markets. Note that this is in keeping with the strong desire and policy of the U.S. Government that American companies, and particularly small and middle-sized firms, begin to export or export more so as to assist our economy to grow and prosper. Thus Silopress is a direct supporter of U.S. Government policy - we are a case example of what our Government wants many other American firms to do.

Participation in the Bulawayo fair represents one of our many efforts to develop the international market for our product. We were invited to participate in the fair by AID itself. We devoted a considerable amount of resources to it; in fact the Chairman of the Board of Silopress Inc., Mr. Leo Fish, and two of our Vice Presidents attended. It was part of a seven-week marketing and sales trip that they made through nine countries of Africa and Europe.

We believe that AID should be congratulated for having the vision to sponsor the pavillion and for inviting a variety of smaller firms with innovative products to attend it. At the same time we wonder why the U.S. Department of Commerce seems uninterested in or unable to support such fairs - in reality this is more Commerce's task than it is AID's. Silopress is pleased that it participated in the fair, and we believe that that is the attitude of most if not all of the other American companies that attended.

Unfortunately Silopress and some of the other comapnies that participated have one problem resulting from the fair - inability to consummate sales because buyers of products and services have not yet been able to get allocations of foreign exchange from their own Governments to pay us.

In our case, we found in Zimbabwe a solid local distributor for our product. The product is needed in Zimbabwe - it can help prevent starvation in that country. Our distributor has been and is prepared right now to purchase one of our machines for testing and demonstration purposes, preparatory to commencing a large-scale advertising and sales campaign. The company applied to the Zimbabwe Ministry of Commerce and Industry for the necessary import license and a modest allocation of AID Commodity Import Program (C.I.P.) funds, and supported this with good written statements from the pertinent local agricultural groups and organizations. We understood that the Ministry of Agriculture also fully supported the company's application. To our surprise and dismay however, we have just been advised by the distributor that both the import license and the AID funds have been denied to the company - in fact the Ministry says that AID funds are "exhausted."

Frankly, this is difficult for us to comprehend. We believe that the machine can make a very important contribution to the improvement of Zimbabwe's agriculture, which is the country's number one economic priority. It will be wanted by farmers, owners of livestock, dairies, and the Ministry of Agriculture. Our distributor is prepared to buy one right now. AID has loaned or granted to the Government of Zimbabwe many millions of U.S. Dollars for the import of American products, especially agricultural machinery. Many more millions of Dollars are in process of being committed for the next several years. In fact, the U.S. is the Number One foreign financial donor to Zimbabwe. Large American companies are selling hundreds or thousands of tractors and other agricultural products to Zimbabwe, financed by AID. Yet a small American company with a low-cost innovative product that spent thousands of its own Dollars to attend the fair at the invitation of the U.S. Government now is unable to sell its product because an import permit and a small amount of AID funds are denied. This we understand is unfortunately also the experience of some other American companies that participated in the fair.

Can the Committee imagine the German Government, or the French or Japanese Governments, inviting their firms to a trade fair, the later results of which are inability of the firms to be paid for their products even though the products are needed and wanted?

Such a conclusion must be prevented in the future. We suggest that when an agency of the U.S. Government sponsors fairs in countries that receive U.S. financial assistance, a modest portion of such assistance be set aside to support the companies (especially smaller companies) that have sales resulting from the fairs.

This leads to a larger issue - how to get more American small companies to participate in AID-financed programs abroad. Actions in such direction also would be in keeping with U.S. Government policy to encourage more American firms to export. The Committee may be aware that AID actually manages two types of funds. One is those with which AID itself directly contracts - so-called AID direct contracts, which are almost always for professional services rather than for products. The second type is funds loaned and granted to foreign Governments - in such cases the foreign Governments actually do the contracting, AID not being a direct party to them. This latter is called host-country contracting, and is primarily for the purchase of products, goods, and commodities. AID actually conducts an excellent and successful program to assist small companies to become aware of and gain professional services contracts under AID direct contracting. But it does not have a good overall system to help smaller firms seek host-country contracts, which in fact are 90 to 95 percent of the funds managed by AID. To put it another way, AID in helping small companies spends most of its time on only a minor portion of total AID-financed business!

We do not mean to suggest that U.S. Government and AID set-aside regulations meant to assist small companies should or could be applied to foreign Governments which receive our loans and grants. The money legally becomes theirs, and it would be unreasonable and unworkable for AID to attempt to require the acceptance of all of our rules, especially the small business set-aside and goaling requirements.

What we do suggest is that AID and other U.S. Government agencies spend more time and resources in assisting smaller companies to become aware of future contracting opportunities under our foreign assistance loan and grant programs. Big companies have their representatives and contacts, in the U.S. and in all parts of the world, to closely monitor and follow such sales opportunities. Small firms cannot afford this, and thus need more U.S. Government help. For example, AID could set up a better, more timely system to advise smaller firms of upcoming host country procurements financed by AID. And AID could consider publishing something for small companies along the lines of the UNDP/World Bank "Business Edition."

One area of host-country contracting in which set-asides for small business could reasonably be considered are the AID C.I.P. programs in such countries as Zimbabwe, Egypt, and Sudan. C.I.P. commitments are large, 30 or 40 or 50 million U.S. Dollars at a time, and there seems nothing unworkable about the U.S. requiring that a certain percentage of such commitments - say 15 or 20 percent - be reserved for competition and/or awards only to small companies. This would, of course, not prevent small firms from also competing for contracts under the remainder of the funds; in fact small companies even now win host-country awards under open competition with larger companies, but existing data on the extent of this is incomplete and unreliable.

A final problem area that Silopress would like to call to the attention of the Committee concerns the amount of AID resources that flow to entities other than private business companies. It is our impression that in recent years a larger and larger share of the total monies managed by AID have been funelled via contracts and grants to non-profit entities such as private voluntary organizations, foundations, universities, and especially other Government agencies such as the Department of Agriculture, the National Science Foundation, the Bureau of the Census, etc. This seems especially true under direct contracts and grants. All business firms - large, medium, and small - suffer when this happens. We are aware that various companies have complained from time-to-time that work given without competition to certain universitites or to the Bureau of the Census, totalling substantial sums of money, could have been performed by business firms. At a minimum it seems to us that companies should be permitted to compete with the non-profits for some of this work. Small business would of course benefit to the extent that a greater share of AID resources were awarded to the private business community as a whole.

Silopress International Ltd. hopes that the above views and comments will be helpful to the Committee in its important work. We are prepared to assist further if you desire.

EXHIBIT 4

UNIVERSITY OF DELAWARE
NEWARK, DELAWARE
19711

DEPARTMENT OF ELECTRICAL ENGINEERING
122 DU PONT HALL
PHONE: 302-738-2408

November 30, 1982

Mr. Mark Levine
Energy Subcommittee
Small Business Committee
U.S. House of Representatives
B-363 Rayburn House Office Building
Washington, D.C. 20515

Dear Mark:

Per your request, enclosed is a brief draft of my thoughts on risk sharing in photovoltaics. Please let me know if I can provide any further information.

Sincerely yours,

Allen M. Barnett
Professor

AMB:jmg

Enclosure

PROPOSED PHOTOVOLTAIC SMALL BUSINESS SHARED RISK PROGRAM

by

Allen M. Barnett
University of Delaware

Prepared for
Subcommittee on Energy
Committee on Small Business
United States House of Representatives

November 30, 1982

THE SMALL BUSINESS CONTRIBUTION

The basic qualities of a small business should be channeled into increasing the photovoltaic options. These qualities include (1) the tendency to develop the most innovative new products, (2) the ability to bring these new products to the marketplace faster and at less cost than large companies, and (3) the ability to develop new markets or to serve existing markets with innovative new products. The innovative and entrepreneurial qualities of small business can make a significant contribution to photovoltaics.

The small business is characterized by the entrepreneur who assumes the risk and management of a business. In contrast, big business no longer is inclined to take risks.

The evidence clearly states that encouraging the entrepreneur gives the greatest probability for achieving a breakthrough idea that can make a significant contribution to our photovoltaic solar cell options. Although entrepreneurs do not only reside in small companies, small business represents the most direct access point for the Government to the entrepreneur.

DIFFICULTIES ENCOUNTERED BY SMALL COMPANIES IN PHOTOVOLTAICS

The cost to demonstrate the feasibility of an innovative new photovoltaic concept is in the $2 to $4 million range. Although the potential market is substantial, sufficient venture capital is virtually unavailable. Venture capital's disinterest is due to 1) concern about the availability of Government support and 2) concern that the entry cost is the $25 million spent by the oil companies, not $2 to $4 million required to demonstrate the concept. Accordingly, sufficient funding for innovative ideas is very difficult for a new company to receive.

SUGGESTIONS FOR GOVERNMENT TO IMPROVE SMALL BUSINESS PARTICIPATION

A photovoltaic breakthrough shared risk program for small companies with a commitment to manufacture solar cells should be offered. (Big companies will not bid their breakthrough ideas.) A clear methodology which will lead to a quantitative determination of which ideas have the potential of leading to a significant breakthrough can be adapted from the photovoltaic literature. This breakthrough grants program should offer multi-year increasing funding for small business ideas which qualify, and for which 50% matching funds can be raised. This grants program will motivate venture capital sources to participate.

When the breakthrough idea is demonstrated, after approximately 2 to 3 years, it will be necessary to build a pilot plant at a cost of $8 to $12 million. Partial funding of the pilot plant stage should be included.

This shared risk program would assist photovoltaic breakthrough ideas through the multiple years of development. For example, this development can be broken down into three stages of feasibility demonstration and four stages of pilot plant demonstrations.

The first year cost to the Government will be less than $10 million for feasibility demonstration, growing to a total of less than $50 million in the sixth year for both feasibility and pilot plant programs and terminating at the end of eight years at a total cost of less than $250 million. Most importantly, 24 new breakthrough ideas can be initiated, 10 pilot plants can be initiated and 4 pilot plants can be successfully operated in the next 7 years. This modest additional expenditure can substantially accelerate the successful development and deployment of cost-effective, commercial photovoltaic energy systems, while stimulating private sector participation and investment.

Since many innovative photovoltaic small business investments show the potential of a higher pay-off than many of the synfuels projects recently funded, the breakthrough idea funding and the pilot plant funding should come from the Energy Security Act, rather than the DOE photovoltaic program which is already stretched thin.

The biggest problem will be convening a review panel capable of selecting the breakthrough ideas. This panel must be discouraged from funding the traditional non-breakthrough approaches. Although a clear methodology exists in the literature which articulates the selection procedure, unfortunately most scientists and engineers have been trained to tell why new ideas won't work, rather than to select innovative approaches.

The proposed new innovative grants program can provide initial support for as many as 24 innovative ideas and companies. Of these, as many as 10 could make a commercial contribution. Most importantly, this infusion of innovative entrepreneurial activity will lead to increased performance from all of the photovoltaic businesses, leading to an earlier, significant contribution to our Nation's energy supply from photovoltaic solar cells.

EXHIBIT 5

ARCO Solar, Inc.
21011 Warner Center Lane
Mailing Address: Box 4400
Woodland Hills, California 91365
Telephone 213 700 7000
Telex 674838
TWX 910 494 2791

December 2, 1982

Mr. Berkley Bedell,
Chairman
United States House of Representatives
Committee on Small Business
Subcommittee on Energy, Environment, and
Safety Issues Affecting Small Business
B-363 Rayburn House Office Building
Washington, D.C. 20515

Dear Chairman Bedell:

ARCO Solar appreciates this opportunity to present some observations on small business and the photovoltaic market. Our views on the significance of the market and the role the federal government can best play are contained in the attached testimony, presented earlier before the House of Representatives Committee on Science and Technology Subcommittee on Energy Development and Applications, delivered on July 13, 1982.

We believe that our observations regarding the importance of the domestic market and financial incentives provided by federal and state policy have relevance to the concerns of this committee. As part of a large corporation, our comments are from the perspective of how we see small business developing that market.

First, we recognize the substantial advantage of small, locally owned companies in the development of a market for photovoltaics. Our technology, due to its modularity and current competitive situation, provides excellent power for remote home uses as well as for other rural uses such as water pumping.

In these applications, the role of the local dealer or distributor is central to both the identification of and sale to the customer. His role as the provider of installation service and maintenance ensures customer satisfaction, and therefore continuing sales through either repeat business or word-of-mouth. Here, the small, locally oriented businessman and his reputation represent a key link from manufacturers such as ARCO Solar to the ultimate marketplace.

The small businessman might also offer expertise on the needs and requirements of a particular type of user. Here, the identification and development of the appropriate balance of systems equipment -- that set of manufactured goods which conditions the power provided by our panels and delivers the light, water, cooling, communications or other output the customer requires -- can best be identified, designed, and in many cases manufactured by the small entrepreneurial businessman who remains close to his market and its needs. The development of such equipment for introduction and use in this country makes its successful introduction to and acceptance by the overseas market much more likely than would be the case without this domestically developed experience.

Finally, we have undertaken an effort to sell systems which will provide utility-scale power, albeit very small-scale utility power compared to most conventionally fueled installations. In such utility-scale installations, we are, of course, relying where possible on local businessmen and contractors for installation. These major projects will aid local dealers and distributors, by showing the public that it can rely on photovoltaic power for its small power needs. At the same time, such projects help increase factory output, so that our costs -- and ultimately, dealers' costs to customers -- can be reduced.

Again, we appreciate your interest in our views on this subject, and we particularly appreciate the concern the hearings show for a very young industry that is attempting to develop during difficult economic times.

Sincerely,

W E Bicker

William E. Bicker
Enclosures
cc: R.J. Arnault
President, ARCO Solar

House of Representatives
Committee on Science and Technology
Subcommittee on Energy Development and Applications

Statement of
James P. Stevenson
Manager, Planning and Analysis
ARCO Solar Industries

July 13, 1982

Mr. Chairman Fuqua, Mr. Fish, members of the Committee: Good morning.

My name is James Stevenson, and I am Manager of Planning and Analysis at ARCO Solar Industries. I have been with ARCO Solar Industries for two years. Prior to that, I performed various assignments in a similar capacity for Atlantic Richfield Company.

I would also like to introduce Dr. Dennis Schiffel, Manager of Corporate Finance at Atlantic Richfield Company, responsible for project financing. He was formerly associated with ARCO Solar Industries and the Solar Energy Research Institute.

ARCO Solar Industries is involved in a variety of renewable resource and energy saving activities, the majority of which are solar related. Our major activity is in the area of photovoltaic research, manufacturing and marketing. Our Camarillo plant is generally recognized as the world's first automated photovoltaic facility. Our photovoltaic manufacturing and marketing activities currently employ approximately 600 people, the majority of whom work in Southern California. In addition, we have a group, ARCO Power Systems, involved in high-temperature thermal applications. ARCO Solar Industries is one of the nine operating divisions of Atlantic Richfield Company, which is headquartered in Los Angeles, California.

ARCO Solar is pleased you have extended an invitation to present our views on the role of business incentives in the development of renewable energy technologies.

For the record, we would like to acknowledge the leadership that this subcommittee has demonstrated in the area of renewable energy. The subcommittee was among the first government bodies to recognize photovoltaics' significant potential contribution to the nation's energy needs. Your actions have facilitated the growth of a potentially major new domestic industry that can contribute to the nation's economy and employment, and offer the promise of increased exports. Your early support of research and technology on photovoltaic and high temperature thermal components was a major contribution to the achievements in these fields to date. These are two of the major renewable energy fields in which we are involved.

The success of your initial research and development efforts in working with the private sector to develop photovoltaic and high-temperature thermal technologies is measured by general recognition of U.S. companies as world leaders in the renewable energy industry.

The industry has now reached the stage in its development where your positive action toward the extension and enhancement of the business energy tax credit will, we believe, result in the continued rapid development and world leadership of U.S.

companies in the renewable energy industry.

We feel business incentives are the most important assistance the government can provide to stimulate renewable technology development and use. Our view on appropriate business incentives for our industry is that they must meet several criteria. First, they should stimulate balanced private sector activity throughout the necessary technical development and commercialization phases. Second, they should be stable and sufficiently long-term to allow for proper planning. Third, they should find the greatest utilization in those areas of the country that have the greatest need as determined by market forces. Fourth, they should be administratively efficient and equitably available. Finally, they should come into play when some form of market efficiency test is passed. We believe a combination of investment tax credits, business energy tax credits and ACRS meet these criteria. Foremost among these business incentives are business energy tax credits.

The Photovoltaic Division of the Solar Energy Industries Association stated its views regarding the importance of business incentives in testimony presented during your Fiscal Year 1983 Authorization Hearings on March 16 of this year. The extension and enhancement of the U.S. federal tax credit was the primary need of the industry presented at those hearings.

As a company, ARCO Solar made its views known regarding the importance of federal energy business tax credits before the Subcommittee on Energy Research and Development of the Senate Energy Committee in hearings held last fall.

In those hearings, a major emphasis was on foreign marketing. ARCO Solar stated that its ultimate objective was the U.S. grid-connected market, but it recognized that a major market might be found overseas. Electricity provided by the U.S. utility grid is easier to obtain and substantially lower-cost than that found in nearly any other country in the world. The most cost-effective application for our technology at this stage is overseas.

In the early years of work on the development of this technology and industry, many observers saw foreign markets as a means of building a successful domestic manufacturing industry and providing incentives for further technical development at this stage of the industry's development.

However, as we noted at some length in last fall's Senate hearings, international marketing of new U.S.-manufactured energy products overseas is very difficult in the absence of the experience, infrastructure and U.S. examples offered by a domestic market. Without this domestic market experience, U.S. companies are and will be increasingly disadvantaged. Our foreign competition is composed of substantial companies. Their governments are supporting their efforts using means that are in keeping with their own economies, legal systems and traditions.

At present, the basic technical lead held by U.S. companies allows them to compete effectively and successfully. The reason for this is that the industry presently is selling primarily to highly technical customers in specialized applications such as telecommunications. However, large-scale exports by U.S. companies have traditionally been preceded by success in domestic markets. The domestic marketplace has shaped the product to fit consumer needs. Competition in the domestic market has stimulated the technical advances and growth of awareness of customer needs in U.S. industry. The experience of directing the technical development in a manner which will reduce cost and increase customer satisfaction provided by the U.S. marketplace has represented the most effective foreign trade stimulation offered by this or perhaps any other nation.

To be successfully marketed overseas, a product which is made in America is aided greatly if it is also "certified" as accepted by the American marketplace by the presence of examples of its use here in this country by satisfied customers. Enhancement of the business energy tax credit for commercial installations would provide the opportunity for that to occur.

The fundamental point we have made in prior testimony before congressional committees bears repeating. The key to the further development and commercialization at home and abroad of renewable energy technologies by U.S. manufacturers is cost reduction in both manufacturing and applications. This cost reduction can best be stimulated by extending the existing 15 percent renewable energy tax credit. Successful commercial sales could be more effectively stimulated by increasing the business energy tax credit to 30 percent for a five-year period and then phasing down to 15 percent for a few years, if needed.

Sales will be stimulated by lower costs stemming from the energy tax credit. Increased sales will promote increased visibility, experience and hence, acceptability.

The continued successful development and use of renewable energy systems depends on their acceptance in the marketplace. Increased sales and use will provide additional experience that should alleviate future user/buyer concern and stimulate further technical advances.

Market stimulation now varies in relation to the differences in business incentives offered by particular states. A considerable proportion of renewable energy business projects are occurring in California because of the state tax credit supplement to the federal credit. We would also note the substantial concentration of our industry in California and the economic activity and increased employement that this activity has brought and will bring to the state. This is consistent with our earlier observation that new industries can best grow and develop in an environment where markets are available to challenge their managers and engineers and provide examples for potential customers.

Enhancing the federal credit to 30 percent would increase the market substantially throughout the nation.
Through use of commercial energy tax credits, the federal government allows and encourages the private sector, its customers, third-party investors and utilities to develop the technology in an effective manner. This will provide the best product for the cheapest price, and satisfy the needs of the consumer for power, reliability and reasonable operation and maintenance costs.

At present, many investors or customers view the capital costs of this technology as too high compared with standard fossil fuel generation systems. In addition, there is concern about the operation and maintenance costs of systems intended to have very long useful lives. Even though the cost of fuel for these systems is "free," the absence of experience regarding the operation and maintenance costs and the high capital costs makes the renewable system seem too much of a risk in relation to their potential return.

An extension of the tax credit will offer time to acquire additional data on operation and maintenance costs, and time for corresponding improvements in design and materials to be developed. Cost reduction of the basic equipment through technical advances provided by market opportunities that the tax credits offer, combined with this data, should substantially reduce the risk perceived by investors.

The exact length of an extension of the existing credits is difficult to recommend at this time for just these reasons. The date of 1990 has been suggested. At this time, we see that as a positive development. But we cannot argue at this time for that precise year or one a few years earlier or later. Our products are new and they have long lives. We and our customers need data from the experience markets presented by the tax credits will provide to make that determination as well as many others.

For us and others in our industry, an increase in the federal tax credit from 15 percent to 30 percent for renewable energy systems and an extension of the credits for a period of five years would be the wisest investment this congress could make. It will be vital to the development of a new energy industry, including related jobs and economic activity. But perhaps most importantly, it offers another tool available to this government to reduce our dependence on imported fossil fuel for the generation of electricity. It also offers the best prospect of a positive balance of trade in renewable energy technology and products. Given the small size of the photovoltaic industry and its current export oriented nature, we believe the cost to the Treasury would be small for extending or enlarging the business energy tax credit. It is exceptionally important to stimulate rapid industry growth now if significant benefits are to be obtained by the late 1980s and early 1990s.

However, we recognize the realities of the current national economic situation and acknowledge and accept the need for acting responsibly in the current federal budgetary situation as well. An extension of the existing credit would itself represent a very positive action.

In conclusion, ARCO Solar is very encouraged by the understanding of the current stage of development and needs of our industry that these hearings by your committee demonstrate. In the very early days of this subcommittee's consideration of the national role in support of these technologies, ARCO Solar managers presented their views on various aspects of the programs under consideration. ARCO Solar has for the most part drawn on our own resources to develop our company. But we have recognized the many positive aspects of your efforts in support of our industry.

Our attention has been focused on the marketplace in which we must compete and develop. The market in its several forms and many locations guides not only our sales efforts, but it provides the challenge, stimulus and discipline for our research and development work. We are confident that we and other U.S. companies can continue to compete successfully in that marketplace. Therefore we are very encouraged that you recognize that extending market opportunities or enhancing them through extending or enhancing the commercial tax credits is proper to consider now. They represent the most effective and efficient means for both American industry and American government to continue the rapid development of a domestic industry so it will remain an international leader and make its contribution to our energy and economy in the future.

Business incentives, including the investment tax credit, ACRS and the current 15 percent renewable energy tax credit, are very important to our industry. We support an extension of the current 15 percent renewable energy tax credit beyond the current expiration date of 1985. We strongly recommend that you consider the enhancement of that credit to 30 percent for the next five years.

Thank you very much for inviting us and considering our views. Dr. Schiffel and I will be pleased to respond to any questions you might have.

EXHIBIT 6

CRYSTAL SYSTEMS INC.
SHETLAND INDUSTRIAL PARK
35 CONGRESS STREET
SALEM, MASSACHUSETTS 01970
(617) 745-0088 TWX 710-347-1528

December 3, 1982

Honorable Nicholas Mavroules
Member of Congress
1204 Longworth House Office Building
Washington, DC 20515

Dear Mr. Mavroules:

Thank you for your letter of November 23 regarding the December 9 meeting of the House Small Business Subcommittee on Energy regarding the photovoltaic industry.

Crystal Systems has been involved in developing technology for the photovoltaic industry since 1975. Crystal Systems has adapted its unique Heat Exchanger Method (HEM) for the growth of large square silicon ingots for photovoltaic application. I am enclosing a news release of January 11 of this year which shows our involvement with the Department of Energy. As the news release indicates, we are commercializing this technology and are currently in a prototype production stage.

HEM is essentially a directional solidification process where the temperature gradient in the solid is controlled by a heat exchanger and the gradient in the liquid is controlled by the furnace temperature. HEM is an important development for terrestrial photovoltaic applications since it is the only process that combines high efficiency and square shape to produce high performance modules. The conventional Czochralski (CZ) process produces a high efficiency wafer, but its round shape allows only 78% of the panel area to be effectively used. Although casting processes produce square-shaped wafers which achieve 98% packing density, their panel efficiency is lower than for round wafers. Using modules with HEM wafers, the cost of photovoltaic installations can be reduced since fewer modules will be required. The enclosed reprint - "Cutting Silicon Wafer Costs for Photovoltaics" - summarizes our program.

Even though Crystal Systems has a technological edge, this is a very difficult time to commercialize this technology. The domestic market for photovoltaics has not grown as rapidly as anticipated because of the present energy glut and the strong dollar has minimized export potential. On top of this, government support for technology that is in the embryo stages, such as this, has been terminated. Your Department of Defense Renewable Energy Utilization Act may be useful in aiding the commercialization of new technologies by creating a marketplace for photovoltaic products made by new technologies. When new technologies have not received sufficient R&D funds, it is difficult for them to compete head-on with technologies that are optimized and have been well established. A great deal of technology development occurs during the prototype stage, which will then allow the technology to excel. In order to accomplish this, the pricing of the new high-technology product will be higher than the conventional product and decrease as experience is gained through volume. To implement this, I would like to see new technology products initially given special consideration.

I hope this information will be helpful to you. If possible, I would like to discuss this in far greater detail with you before the December 9th meeting.

I look forward to hearing from you on this shortly.

Sincerely yours,

Frederick Schmid

Frederick Schmid
President

CRYSTAL SYSTEMS

news release

RELEASE DATE:
January 11, 1982

SALEM, MA--Crystal Systems, Inc., is manufacturing square silicon ingots on a full-production basis with a new silicon crystal growth technique -- the Heat Exchanger Method (HEM). The Department of Energy's Dr. Morton B. Prince stated that, "This is the first crystal growth technology to go into production that was undertaken from the concept stage under a DOE contract." He further stated that, "The HEM technology is a significant development for making photovoltaics viable."

The Heat Exchanger Method, used for production of the world's largest high-quality sapphire, was adapted to grow square silicon ingots under a five-year multi-million dollar DOE/JPL contract. Dr. William T. Callaghan, Manager of the Jet Propulsion Laboratory's photovoltaics project, indicated that the HEM was selected by JPL as a prime technology for producing square-shaped high-efficiency material for photovoltaic applications. Callaghan said, "Crystal Systems has made significant technical breakthroughs in silicon crystal growth."

Frederick Schmid, president of Crystal Systems, stated that in contrast to the current industrial production technique which produces cylindrical ingots 4 to 5 inches in diameter, the HEM produces ingots with a 13" x 13" cross-section. The large crystals are cut into nine 4" x 4" bars and sliced into wafers for solar cells.

Under a DOE contract, Crystal Systems is also developing a new slicing technology -- the Fixed Abrasive Slicing Technique (FAST) -- for more effectively slicing silicon bars into wafers. This technology is expected to be in production in two years.

FOR MORE INFORMATION CONTACT:

Frederick Schmid
Crystal Systems
35 Congress Street, Salem, MA 01970 (USA)
617/745-0088

CUTTING SILICON WAFER COSTS FOR PHOTOVOLTAICS

by Frederick Schmid and Chandra P. Khattak

Photovoltaics—the direct conversion of sunlight to electricity—is young, but picking up speed due to increasing energy costs and government-sponsored R&D. Up to this point, what has kept rapid market growth in check is the high cost of solar modules.

Whereas in the semiconductor industry, silicon wafer cost is one percent of the final cost, here it is one-half the module cost. Moreover, most photovoltaic companies are vertically integrated and cannot compete with the semiconductor industry for standard wafers. Solar module manufacturers are dependent on reject or over-supply wafers, but this supply is limited and will quickly run out as demand piles up.

Even so, many programs are steering toward lower cost. The Department of Energy, with the Jet Propulsion Laboratory as technical monitor,[1] has funded significant R&D efforts, and many companies have programs to cut the silicon starting materials cost, as well as the cost of processing this material into wafer or sheet. These programs—ultimately directed toward reducing the cost of silicon wafers for solar cells—have been around for about five years.

Producing silicon starting material

Present-day semiconductor grade melt stock is produced at $60 to $90/kg by the Siemens process using trichlorosane as its starting material. Trichlorosilane, in turn, is made from metallurgical grade silicon. According to DOE, to make photovoltaics competitive,[2] the starting materials for crystal growth should cost no more than $14/kg.

For now, a number of companies have put a variety of approaches and objectives into play to reduce the cost of the starting material. These efforts can be grouped into two categories: reducing the cost of semiconductor grade starting material and improving the purity of less-refined silicon.

Chemical producers, under DOE sponsorship, are exploring several approaches to reducing the cost of semiconductor grade starting material. The methods include the dichlorosilane process and the silane process, which, with faster reaction rates and recycling of byproducts at various stages, drive toward the $14 figure. But integrated circuit and photovoltaic manufacturers will be competing for a short supply of semiconductor grade melt stock, which is the raw material for both industries today and which indicates that the price and availability of this material for the photovoltaic industry would pose a problem.

The methods for improving the purity of less-refined silicon are: production of metallurgical grade silicon (i.e., solar metallurgical from purer starting materials); decomposition of $SiCl_4$; refining of MG silicon with aluminum; and reduction of silicon fluorides with sodium. All of these processes can produce silicon starting material at less than $10/kg.

The silicon sheet development programs fall into two areas: ingot growth

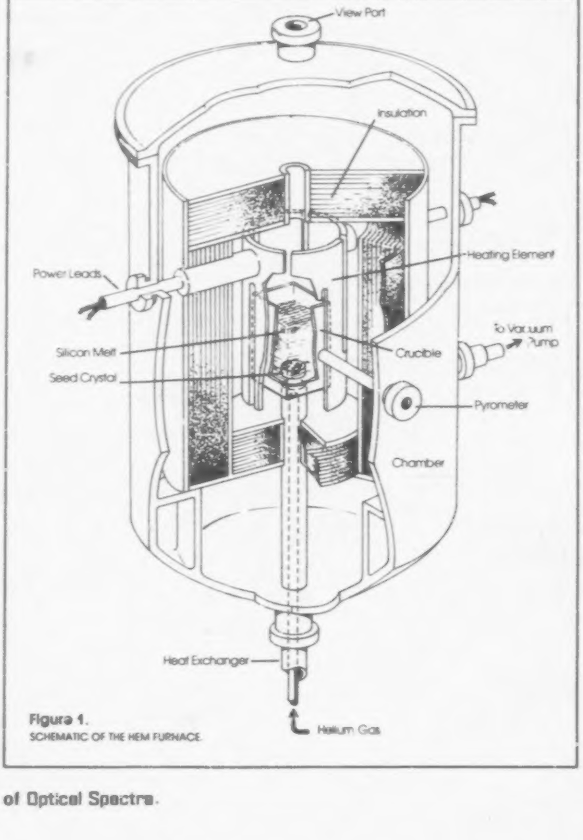

Figure 1.
SCHEMATIC OF THE HEM FURNACE

Reprinted from the May 1981 issue of Optical Spectra.

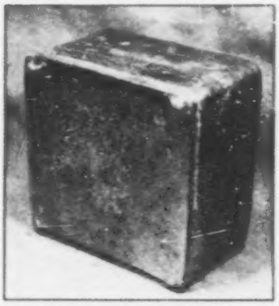

Figure 2.
A 30 × 30CM SQUARE HEM SILICON INGOT

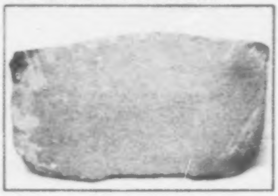

Figure 3.
CROSS SECTION OF HEM INGOT USING METALLURGICAL GRADE SILICON

process and ribbon techniques. On one hand, to produce wafers, the ingot technology must be combined with a slicing process, the bottleneck for effectively converting silicon ingots into sheet.

On the other, ribbon processes under development work to eliminate the slicing operation entirely by producing sheet directly from the melt. All in all, the performance of ribbons produced by processes using dies or edge-stabilizing rods is inferior to material produced from CZ wafers.[3] And since single-ribbon growth may not be as cost-effective, companies are exploring multi-ribbon growth.

The dendritic web technology, in which a silicon web grows between vertical dendrites growing out the melt, appears capable of forming high-efficiency cells,[4] but so far the material throughput of this single-ribbon process has yet to be demonstrated. There is no purification effect at the projected rapid speeds of pulling ribbon; hence these technologies must use semiconductor quality melt stock.

The most developed crystal ingot growth process is the CZ process, which produces high-quality round ingots primarily for the semiconductor industry. Melt replenishment being developed to lower processing cost will reduce expendable crucible cost, but will also add to the intricacy of the equipment. Moreover, this technique cannot use lower purity silicon melt stock with float impurities.

Still another alternative is casting ingots in a mold. Fast cooling rates produce small grains that grow off the mold wall, and the efficiency of this material is degraded particularly in the area where the growth interfaces meet.[5] It appears that high-purity silicon is necessary for this approach, and that cost reduction may not be substantial enough to offset the drop in performance.

Work with HEM

As part of the DOE program, we have adapted our motionless Heat Exchanger Method (HEM) to grow large, square, single-crystal ingots specifically for photovoltaics.[6] In this method, which uses commercially available material, a heat exchanger is inserted into the heat zone of a graphite resistance furnace (see Figure 1). The heat exchanger removes heat from the seeded melt to cause a crystal to grow by continually increasing the flow of helium gas through the heat exchanger.

The square shape and high solar cell efficiency produced permit fabrication of high power density modules to reduce the over-all cost. The 30 × 30cm cross section (100) crystal shown in Figure 2 can be sectioned into any size bars for slicing into rectangular wafers.

Moreover, the submerged solid-liquid interface in HEM allows the use of all grades of silicon melt stock. During crystal growth many impurities float on the surface. HEM can produce single crystal ingots from metallurgical grade melt stock, as shown in Figure 3. The solid-liquid interface expands from the bottom center to the sides as growth proceeds, and effectively rejects impurities to the outside of the boule where they will be removed to meet dimensional tolerances.

Using semiconductor grade melt stock has produced solar cell efficiencies of over 15%, equivalent to CZ-processed silicon, as shown in Figure 4. Lower purity silicon melt stock, commercially available metallurgical grade, when solidified by HEM has produced over 7% efficiency as compared to 2% for the CZ process.[7] With a laboratory-produced MG silicon, HEM has demonstrated over 12% efficiency,[8] and epitaxial solar cells on HEM-processed metallurgical silicon have produced 12% efficiency.[9]

Slicing is critical

For any ingot technology to be cost-effective for photovoltaics, it must be combined with a low cost slicing technology. In slicing ingots into wafers, ingot utilization (kerf plus slice thickness) and blade cost are major factors. Conventional slicing technologies for semiconductor silicon consist of: internal diameter (ID) slicing; multi-blade slurry (MBS); and multi-wire slurry (MWS).

Today, internal diameter (ID) technology is the most developed method of slicing, and it has been used commercially in the semiconductor industry where ingot utilization has not been a major factor.

We have developed and patented the fixed abrasive slicing technique (FAST).[6] This process has been applied to silicon and involves both a high-speed slicing machine and multi-wire blade development. The concept of fixed diamond abrasive—as used in industry-wide ID slicing—is transferred to use of thin wire blades. The diamond-edged wires are assembled into a multi-wire bladepack, stretched to high tension and reciprocated at high speeds in the multi-wire slicer.

A matter of cost

Although the cost of processing silicon into wafer is significant, the single biggest problem hindering large-scale photovoltaic market development is the availability of low cost semiconductor quality silicon melt stock—that is the starting material itself. Virtually all photovoltaic processes other than HEM require semiconductor-quality starting material, and HEM has been able to grow single-crystal silicon from lower purity silicon. ☐

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Meet the authors

Frederick Schmid received a bachelor's degree from Lafayette College in 1959, a master's degree from Northeastern University in 1967 and studied at MIT. Founder and president of Crystal Systems Inc. in Salem, Mass., he is co-inventor of the heat exchange method and holds 6 patents on solidification and slicing. He has received two IR-100 awards.

Dr. Chandra P. Khattak is vice president of technology at Crystal Systems. Formerly on the science staff at Brookhaven National Lab, he received his bachelor's degree from ITT in Bombay, India, and a master's and doctorate from Stonybrook, State University of New York.

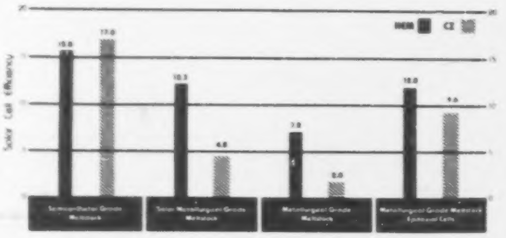
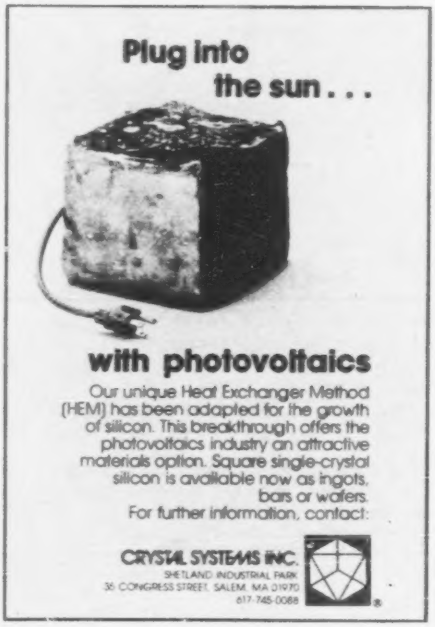


Figure 4.
THE SOLAR CELL PERFORMANCE OF HEM SILICON COMPARED WITH INDUSTRY STANDARD (CZ).



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For further information, contact:

CRYSTAL SYSTEMS INC.
SHETLAND INDUSTRIAL PARK
36 CONGRESS STREET, SALEM, MA 01970
617-745-0088

EXHIBIT 7

Mobil Tyco Solar Energy Corporation

VERN W. WEEKMAN, JR.
PRESIDENT

December 6, 1982

Representative Nicholas Mavroules
1204 Longworth H.O.R.
Washington, D.C. 20515

Dear Congressman:

I appreciate your November 23 request for comments regarding the government's role in encouraging the development of the U.S. photovoltaic (PV) industry. Since other business commitments will prevent me from attending the December 9 session, I am providing these remarks.

The PV industry is an "infant industry" with an assured role in the nation's long-term energy portfolio. However, given the a predictable market lag between the commercialization of our proven technology and its widespread adoption in the market, there is a need for market stimuli, provided by government during the lag period, to assist us in transiting our market "adolescence" phase.

More broadly, both residential and business renewable energy tax credits are very supportive, to hasten market introduction of significant energy alternatives during this period of rapid growth in PV industry capacity. By allowing the market to determine which emerging energy technology satisfies customer requirements most effectively, the tax credit mechanism is the most neutral economic instrument to be employed by government in assisting the renewables community, and relieves government of the well-nigh impossible job of "picking the winner" in this complex technological environment.

As the industry's producers attain economies of scale production levels in the future, I am confident that we will be able to compete directly with many, if not all, other electrical energy sources; and without tax credit assistance. The termination of these tax credits at the end of 1985 is premature, however, and is already creating substantial procurement uncertainty among consumers of PV with respect to many future projects.

What is needed therefore, is an extension of those credits for a sufficiently long period so as to create customer confidence in the price stability of PV and other renewable products. Since the industry must succeed of its own accord over the long term, the credits should be ended by 1990 at the latest, under a gradual, specified series of tax credit reductions. Such phased reductions would eliminate the sudden market shocks consequent to an abrupt termination of a 40% "bargain" rate.

The proper implementation of the Public Utility Regulatory Policies Act (PURPA) may be even more significant than tax credits. The renewable energy industry overall and PV in particular will be able to compete effectively with other energy sources in this decade, but only if we are allowed full and reasonable access to the public grid. Congress should monitor closely the implementation of PURPA at the state level, to assure an administration of PURPA which is faithful in substance and spirit to the purposes of the Act. Excessive PV/grid intertie costs and procedures constitute inequitable, uneconomic, and wholly wasteful barriers to entry which will jeopardize the development of a broad-based national energy system, to the public's detriment.

An even-handed treatment of all energy sources is as necessary in energy R&D as it is in final power generation and distribution. The nation cannot afford to allocate the vast majority of its public funds to only one or two energy sources, at the expense of other equally promising alternatives. Sound development of our energy resources requires a government industry policy of at least relative equality ("parity" if you will) in the financial treatment of all forms of power generation at the same stage of technological evolution. Such parity is now sadly lacking, and leads to a serious misallocation of public and private resources among energy technologies.

Finally, government has a key role in ensuring that U.S. renewable energy products can compete fairly with our foreign industry colleagues both in their own countries and in third party markets. Such a role requires an aggressive ferreting out and removal of tariff and non-tariff barriers to trade. It means energy system financing assistance from Ex-Imbank and OPIC. And it means serious attention by the Commerce Department to the aggressive promotion of the industry through exhibitions, catalog shows, and information distribution around the world.

The PV industry today already confronts a vibrant global market in a classic economic sense. The technology is emerging rapidly, technology transfer is occurring at an astonishing pace, national competitors are developing everywhere, product pricing is highly competitive, and PV utilization is increasing enormously. Our industry profile by 1990 will be akin to that of the semiconductor industry today. My theme in this letter is straightforward. The U.S. government can foster the emergence of a large and dynamic industry primarily by seeking to create and enforce the conditions of a fair marketplace with respect to intra-industry government financial support and access to the grid domestically, and to open trade conditions worldwide.

Sincerely,

Vern W. Weekman

Vern W. Weekman

VWW/efb

13 December 1982

Congressman Berkley Bedell
House Small Business Committee
B363 Rayburn House Office Building
Washington, DC 20515

Dear Congressman Bedell:

On December 9 I attended the hearing of the "Subcommittee on Energy, Environment and Safety Issues Affecting Small Business" dealing specifically with "Marketing Opportunities in the Photovoltaic Industry". I was very impressed with the manner in which you were coming to grips with a very complex issue indeed. It appears that in order to solve the problems of the photovoltaic industry requires a knowledge of our own country's capabilities, the world's capabilities and intentions, the workings of all of our federal agencies, and insights to the future.

I attended the hearing on the recommendation of Congressman Mavroules of Massachusetts. I am trying to understand how HR 5005, the "Department of Defense Renewable Energy Utilization Act of 1982" may be carried out, and what its impact might be on the future of the renewable energy industry. As such I'm trying to understand the thinking of Congress regarding renewable energies. Background material on the HR 5005 is being provided to me by Congressman Mavroules' office.

It is my understanding that official transcripts of the December 9 hearing are available. If so, I would like to obtain a copy. Any other material that will help me in assessing the ability for the renewable industry to meet the potential demands of the above-mentioned DOD Act is also appreciated.

The various testimonies given at the December 9 hearing have discussed all of the important issues affecting opportunities for small businesses in photovoltaics and the future of photovoltaics itself. As I see them, they can be summarized as follows:

1. Maintain or even increase domestic tax credits for renewable energy investments

2. Increase the level of R&D funding for renewable energy technologies

3. Increase assistance by the Federal Government in international trade fairs and shows and provide education or know-how on the other countries' environment

4. Provide a focal point within the Federal Government for Renewable Energies to which small businesses can turn for help and where they can find other assistance opportunities within the Government.

I would like to add a comment about the international business opportunities in photovoltaics, or for that matter for any of the renewable energy technologies. A great deal was said about the large market potential that exists in the lesser developed countries (LDCs). Although that potential is there, it should not be confused with how much is realizeable. The LDCs have typically a chronic imbalance of payments and are always seeking foreign cash to fund their own industrial and social programs. Renewable energy technologies are capital intensive which, although certain to pay off in the long run, tend to be a severe drain on the resources of the LDCs. Whatever markets exist are often funded by loans, aids, or grants the LDCs receive from the industrialized nations. The more sophisticated LDCs are more than likely to insist on in-country production capabilities. Thus joint ventureships are more likely to influence the long-term markets for U.S. businesses. Anything to facilitate these opportunities would be of great help.

I hope that my comments are helpful in your task and that the materials requested above can be made available.

Yours truly,

SCIENCE APPLICATIONS, INC.

Peter L. Versteegen

Peter L. Versteegen

Northern Energy Corporation

LAWRENCE LEVY
President

December 14, 1982

The Honorable Berkley Bedell
United States House of Representatives
2440 Rayburn House Office Building
Washington, D.C. 20515

Dear Congressman Bedell:

I was sorry that a Board of Trustees meeting prevented me from attending your hearing on December 9 to explore current market conditions for photovoltaic (PV) energy equipment.

As you may know, Northern Energy Corporation operated the Northeast Solar Energy Center (NESEC) for the Department of Energy for five years, until our contract was terminated by the Administration because of a lack of support for solar commercialization activities. One of the solar technologies for which we had responsibility was PV, and our important commercialization work in that field was just beginning to get going.

I have said for some time that PV is the "sleeper" in the solar business, that is it represents the one solar technology that has real potential for large domestic and foreign markets. I have deplored the reduction of the Federal program for PV, and call your attention to the President's Column in the April 1981 issue of NESEC Update, the newsletter that we published for several years prior to our contract termination. You will note that this article raises the same deep concerns about the U.S. losing the lead in PV and other solar technologies.

You are to be congratulated for holding this important hearing, and I would very much appreciate receiving a copy of the transcript when it is ready. If there is anything that I can do to assist your effort, please do not hestiate to let me know.

Sincerely,

Lawrence Levy

Lawrence Levy

LL:jml
Enclosure

Carbone
Investment
Management Co.
Certified Investment Advisor
570 Dwight Place, Berkeley, CA 94704
(415) 843-2835

December 14, 1982

Congressman Berkley Bedell
U.S. House of Representatives
Committee on Small Business
Washington, D.C. 20515

Dear Congressman Bedell:

After researching the photovoltaic industry for several years, we know this technology offers enormous benefits for mankind and will become a commercial success far sooner than the Reagan administration and conventional-energy leaders wish us to believe.

Our research proves beyond any reasonable doubt that the necessary technology for mass production of solar cells is at hand. Our most necessary needs now are public awareness and adequate financing.

As your committee has documented very well, when new technology must be introduced, it is almost always the American small business that comes through with the necessary innovations and solutions.

We firmly believe that the PV industry can in no way depend upon the Reagan administration for help in further development at this critical stage. Reagan is aligned with big business--his political base--and, realistically, he is unlikely to change sides or suddenly learn to believe in the genius of the smaller entrepreneurs.

Although economical photovoltaics will certainly benefit government applications, such as the space program, it will mostly benefit the average American as it supplements conventional electrical generating plants. PV technology is revolutionary in nature and will disrupt a number of established industries. It certainly can replace nuclear power.

We can hardly expect the oil companies and other corporate giants to be the technical pioneers in photovoltaics!

The alternative is Wall Street. We must encourage the PV industry leaders to honestly communicate the rapid technological progress being achieved now and the benefits and profits soon to come.

We have been and always will be, let's hope, a nation of Ben Franklins and Thomas Edisons, people who seem to come out of the woodwork when we need them most.

The PV industry does have its share of technological wizards, and America must support the important advances being made by such people in the photovoltaic field.

We are talking about *clean* energy--and in the near future, at that.

Sincerely,

Robert C. Carbone

Robert C. Carbone
President

RCC:lh